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Production and Marketing of Wheat in North America.

J. F. BOOTH

Department of Agricultural Economics, Cornell University, Ithaca, N.Y.

The growing and marketing of wheat has ttained such wide recognition today that most people are acquainted with it as a commodity or consumption, or as an article in international trade. It has become one of the most important commodities in the life of civilized people but, like anything that is continually before our view, we see it only on the surface, and little realize what is behind its present status, who made it what it is, and what it was like before it assumed its present proportions. Someone has said that 'it is hard to see the trees for the forest', and so it is with the growing and marketing of wheat.

Today three classes are interested in wheat: producers, dealers and consumers. Of these it is probable that the farmer knows least about the history of the commodity he grows. It is not surprising that this should be so, for he is by nature a practical man and makes his living by growing wheat, not by studying its history. Here and there, however, we find those who desire more knowledge than they can get from the school of experience. At one time such persons engaged in agricultural pursuits were known as 'book farmers' and were the subjects of much amusement in the community. In the same manner investigators, experimental stations and colleges were smiled upon—taken good naturedly but not seriously.

Times change, however, and of recent years farmers have found out that the school of hard knocks did not discover the formalin treatment for smut, nor what poisons were of use in controlling outbreaks of grasshoppers, nor how inoculation of legumes improved their growth and left in the soil more nitrogen. Neither did the old school teach men how to create the new varieties of wheat which have pushed the wheat belt almost to the Arctic Circle. These are the things that others must do, and the wise man today is he who reads sufficiently to keep abreast of the times.

Experience has, however, taught most farmers that they need more information on the marketing of their crops, and to none has this need been more apparent than to the wheat farmer. Any information on this subject is eagerly sought today, and it is with this object primarily in mind that this article has been prepared. If it brings to the farmer, the dealer, or the consumer a little of what has preceded the present discussion on wheat marketing, it will have served its purpose. It should not be thought of as an exhaustive treatise on the subject.

EARLY HISTORY OF WHEAT IN AMERICA

Wheat was not indigenous to North America. As far as is known there was no wheat here before the coming of Europeans. How long it had been grown in the old lands is not known. There are frequent references to wheat in the Bible, and the investigation of the contents of Egyptian tombs has brought to light wheat which must have been grown several thousand years ago. It has been cultivated continuously on many parts of the Continent since these early Biblical times. It is with the introduction of the crop into America and its subsequent growth, however, that we are most concerned.

What appears to be the earliest account of wheat being introduced into America is to be found in a letter from Cortez to the King of Spain, in which he says:

> "I beseech your Majesty to give orders that no vessel sail to this country without a certain quantity of plants and grain."(1)

In another account we find the following:

> "The foundation of the wheat harvest of Mexico is said to have been three or four grains accidentally taken by a slave of the conqueror in 1530, which he carefully cultivated and preserved." (2)

1 From the Report of the Commission of Patents, Washington, 1853.

2 Ibid.

So much for the introduction of wheat into the southern part of the Continent. One of the earliest references we have to wheat in the northern section is to that sown on the Elizabeth Island in Massachusetts in the year 1602, by Gosnold. In 1611 it was introduced into Virginia, and soon became popular, a premium being offered for its cultivation in 1651. Just when the first wheat was grown in the New Netherlands is not quite clear, but reference is made to certain samples which were sent to Holland from Manhattan Island in 1626. We also find that the Governor of Massachusetts Bay ordered wheat, among other things, to be sent over from England in 1629. It is interesting to note that one of the earliest quotations on the price of wheat in New Netherlands was given in 1635 as 2 florins per skepel (60c per bushel); while on the river Piscatauqua in 1680 wheat was quoted at $1.25 per bushel. (3)

Of course during this early period the wheat produced was purely for home consumption, consequently very small acreages were cultivated. Nothing of a commercial trade had been developed. The grain was ground into flour on the farm, by very crude processes—at first by means of stones, and later in home or local grist mills which were to be found on most of the streams. If a surplus was produced, it was generally consumed in larger quantities, taking the place of something else that was short, or it was traded to a neighbor who had something to offer in exchange.

Very few records are available to show exactly when the first wheat or flour was shipped from the new continent. Undoubtedly small shipments were made during the latter part of the 17th century and the early years of the 18th; but the first records the writer has been able to obtain of shipments in any quantity, are given for the years 1749 to 1771. The quotation reads as follows:

> "The amount of flour exported from New York in 1749-50 was 6721 tons, besides the grain estimated by the bushel: In 1756, 80,000 barrels; from New Jersey in 1751, 6424 barrels; from Philadelphia in 1752, 125,960 barrels, besides 86,500 bushels of wheat; in 1771, 252,744 barrels; in 1772, 284,827 barrels; in 1784, 201,305 barrels; in 1787, 193,720 barrels; in 1791, 315,785 barrels; Savannah in 1771, 7200 pounds; from Virginia for some years annually preceding the Revolutionary War 800,000 bushels."(4)

3 Ibid.
4 Ibid.

TOTAL EXPORTS FROM THE UNITED STATES IN WHEAT (5)

Year	Flour (barrels)	Wheat (bushels)
1791	619,681	1,018,399
1800	653,052	26,853
1810	798,431	325,924

EXPORTS OF WHEAT AND FLOUR FROM THE UNITED STATES 1820-1853. (6)

Year	Wheat (bushels)	Flour (barrels)
1820-21	25,821	1,056,119
1821-22	4,418	827,865
1822-23	4,272	756,702
1823-24	20,373	996,792
1824-25	17,999	813,906
1825-26	45,166	857,820
1826-27	22,182	868,492
1827-28	8,906	860,809
1828-29	4,007	837,385
1829-30	45,289	1,227,434
1830-31	408,910	1,806,529
1831-32	88,304	864,919
1832-33	32,221	955,768
1833-34	36,948	835,352
1834-35	47,762	779,396
1835-36	2,062	505,400
1836-37	17,303	318,719
1837-38	6,291	448,161
1838-39	96,325	926,151
1839-40	1,720,860	1,897,501
1840-41	868,585	1,515,817
1841-42	817,958	1,283,602
1842-43	311,685	841,474
1843-44	558,917	1,438,574
1844-45	389,716	1,195,230
1845-46	1,613,795	2,289,476
1846-47	4,399,951	4,382,496
1847-48	2,034,704	2,119,393
1848-49	1,527,534	2,108,013
1849-50	608,661	1,385,448
1850-51	1,026,725	2,202,333
1851-52	2,694,540	2,799,338
1852-53	3,890,141	2,920,915

It is interesting to note the production of wheat in the United States for certain years about this same time: (7)

5 Ibid.
6 Ibid.
7 Ibid

PRODUCTION OF WHEAT IN THE UNITED STATES.

Year	Production (bushels)
1840	84,823,272
1850	100,485,944
1853	110,000,000
1860	170,176,027

Part II Patent Office Reports, Washington, 1852.

From an early volume of Niles' Register, published in 1815 we find a table of prices for the port of Philadelphia for the years 1772-1789: (p. 138, v. VIII). (8)

SALES OF FLOUR AT PORT OF PHILADELPHIA.

(Average price per barrel of 196 pounds in pounds, shillings and pence)

	£	s.	d.
1772	1	19	10
1773	2	0	2
1774	1	18	1
1775	1	15	2
1776	1	11	7
1783	2	5	6
1784	2	7	7
1785	2	4	2
1786	1	19	11
1787	2	0	0
1788	1	15	6
1789	1	13	8

EXPORTS OF WHEAT FROM PHILADELPHIA, 1789.

(in pounds and shillings) (9)

	£	s.	
192,762 barrels flour @	2	1	per bbl.
100,181 bushels wheat @		8	per bu.

8 These figures are used in an article (author unknown) exhorting the farmers to cheapen production and not to expect war prices to prevail. He says, "If then peace is preserved on the Continent and every nation there husbands its resources, as we may expect they will—it seems to result, as a natural consequence, that we shall lose the markets for our food almost wholly, or consent to sell to Europeans cheaper than they can supply themselves."

9 American Museum, v. VIII, p. 114, quoted in Niles' Register, v. VIII, 1915, p. 138.

These prices will be particularly interesting as a means of comparison with prices of the present day when it is borne in mind that a barrel contains two of our present sacks of flour.

During the period mentioned above the acreage of wheat was small and entirely confined to the Atlantic seaboard. Very soon, however, settlements grew up along certain navigable rivers, notably the Hudson. Since there were no railrads thought of at that time, it was impossible for the settlers to go any considerable distance from the water routes. As a result we find that settlements extended only about the distance of a day's journey from the rivers or the coastline. Of course gradually the settlements extended somewhat farther inland, but only as roads were developed, making it possible to bring in larger loads from a considerable distance. All roads led to the larger cities, Philadelphia, Boston and New York, from which the bulk of the shipments were made. There was, of course, nothing in the nature of special facilities for handling grain. Elevators were unknown at that time. Wheat, therefore, had to be handled in sacks and the flour in barrels.

At these river ports were to be found buyers, who appeared regularly at the proper season to contract the farmer's crop, much as has been the custom even of recent years with the purchase of potatoes, fruit, etc. Such was the system of marketing wheat during that early period.

THE INDUSTRIAL REVOLUTION AND WESTWARD EXPANSION.

Along toward the close of the 18th century these larger centers in the eastern United States and Canada began to assume the proportions of industrial centers. The introduction of manufacturing processes, following the inventions in Europe of the spinning wheel, power loom, processes for smelting iron, and other similar inventions which were revolutionizing Europe, soon had the same effect on the eastern sections of our Continent. About this time also Watt built his steam engine, which opened the way for tremendous development in the use of steam power; mining became of much importance;

iron was extensively used in manufacture. Coal was needed for the smelting furnaces, so we find not only extensive developments in coal and iron mining, but also in factory developments, which made use of these products in the manufacture of various types of machinery. These early industrial centers were soon to be found on most of the larger rivers in the east, where use was made of water power until such time as the introduction of steam and electricity became more general.

With this vast development of manufacturing came a heavy demand for workers, and a steady drift from the farms to the cities, to supply this need, followed. Naturally enough there were fewer people left in the country to produce; likewise there was evidence to prove that the lands of the east, in certain sections at least, were becoming exhausted. Reference is made to this condition in a number of places, but one of the best accounts of what was taking place is to be found in an essay on the growth, etc., of the wheat plant, written in 1862 by John H. Klippart, in which he says: (10)

> "But many parts of New York that formerly produced 25 bushels of wheat to the acre, do not average over 5 bushels; and many parts of Maryland, Virginia and Delaware, that formerly produced abundantly, will not now pay the cost of cultivation. Exhaustion is written all over them in language too plain to be misunderstood."

These two conditions, added to the demand for increasing quantities of cheaper food, probably were largely responsible for the expansion westward.

Again, as might be expected, settlements took place mainly along the rivers and lakes. Records go to show that even at this time there was a considerable difference of opinion as to the possibilities of making a living so far inland. The following quotation is rather interesting and to the point: H. Niles, in his article "The Western Country" (Weekly Register, v. I, 1811, p. 9), calls attention to Lord Sheffield's book on "Observations on the Commerce of the American States", written in 1784, in which his Lordship casts much doubt on the possibility of ever making the inland region of the United States of value commercially, he holding the view that it was too far from the seaboard to enjoy commerce; 27 years later the population of Ohio is given as 230,849, all of which came during that period.

Notwithstanding the doubts of certain persons at the time, a fairly rapid development took place, along the Ohio River particularly. Even earlier than this period wheat had been introduced into this territory by a company known as the Western Co., as early as 1718; and in 1746 records show that 600 barrels of flour were received in New Orleans from the Wabash, while in 1750 the French in Illinois, near the site of the present city of Chicago, raised three times as much wheat as they consumed, and sent the surplus down the river to New Orleans.

The first records of wheat shipments to any considerable extent by this route are given for the period from October 5, 1810 to May 5, 1811. A quotation from Niles' Register, v. 1, 1811 contains the following interesting account:

> "During the period October 5, 1810 to May 5, 1811, the following boats and loadings passed the falls of the Ohio (reported by regular pilots, whose business it was to assist boats over the rapids).

Boats	743
CONTENTS:	
Flour, barrels	129,483
Bacon, pounds	604,810
Whiskey, barrels	9,477
Cider, barrels	2,513
Pork, pounds	13,562
Apples, barrels	2,513
Oats, bushels	4,020
Corn, bushels	47,795
Merchandise	$355,624
Cheese, barrels	5,141
Yarn and cordage, pounds	113,015
County linen, yards	8,140
Beer, barrels	277
Beans, barrels	606
Plank, feet	1,483,130
Butter, pounds	24,691
Live hogs, number	908
Cider, royal	1,350
Lard, pounds	465,412
Onions, barrels	218
Potatoes, bushels	1,811
Hemp, hundredweight	630,562
Dry fruit, barrels	263
Fowls, number	1,207,338

10 U.S.D.A. Report, 1862, p. 67, Washington.

Shoe thread, pounds	2,592
Horses, number	292
Tobacco, hogsheads	2,311

And other articles too numerous to mention.

The table is given in full in order that the reader may have an idea of the diversity of farming at this early period, and to show the prominent place that flour exports occupied.

The author of this article goes on to say that many more cargoes passed down the river during high water season, when they did not need the assistance of pilots to see them over the rapids. During such periods no records of shipments were to be obtained. The author of the Register says, in speaking of the Ohio River, "Its waters are enlivened by the appearance of majestic ships bound to the sea."

About this same time the production of wheat in eastern Canada, at a considerable distance inland, was taking place, and here too the development followed the rivers and lakes, most of the production of these parts being along the St. Lawrence River and its tributaries, or on the north shores of the lakes Ontario and Erie. The following figures of wheat exported from Canada show the extensiveness of the movement even at this early time: (11)

"Exports from Canada 1763-1793 varied from 120,000£ to 300,000£, chiefly wheat, furs and pelts.

"During the next 3 years Canada exported 136,500£ of wheat, corn and biscuits.

"In 1802, 1,010,000 bushels of wheat and 38,000 barrels of flour were exported from Canada."

THE DEVELOPMENT OF RAILROADS

While a steady expansion in the acreage put into wheat is to be noted during these early years, it should also be kept in mind that progress, as we consider such today, was slow. It was more than 200 years from the time wheat was introduced into North America before it began to assume any considerable volume of production for marketing. This development could not be expected as long as settlement was confined to an area bordering the seacoast, lake shores and rivers; but with the development of steam power and the building of railroads a great change took place, and more progress was recorded in a decade than had previously taken place in a hundred years. Railroads began to push their way westward in the late 40's, and a considerable mileage was in use as early as 1850. Something of the expansion of railroads may be noted from the following figures: (12)

DEVELOPMENT OF RAILROADS IN WEST

State	Milage	
	1850	1860
Michigan	342	799.125
Wisconsin	20	922.50
Iowa	—	679.75
Illinois	110.50	2867.9
Indiana	228	2125.9
Ohio	55.25	2999.5

It will be seen that during the decade 1850-60 great progress was made. To show the effect of railroads on increased production it is only necessary to give the production of wheat for the same states during the period:

PRODUCTION OF WHEAT IN WEST (13)

State	Bushels	
	1850	1860
Michigan	4,925,889	8,313,185
Wisconsin	4,286,131	15,812,625
Iowa	1,530,581	8,433,205
Illinois	9,414,575	24,159,500
Indiana	6,214,458	15,219,120
Ohio	14,487,351	14,532,170
Minnesota	1,401	2,195,812
Texas	41,729	1,464,273

The whole complexion of wheat growing was changed from that time on. No longer was it necessary to confine settlement to the rivers and water fronts. Railway development took place to the west, southwest and northwest, and during the first few years brought vast areas of productive wheat land within the possibilities of production. The opening of lands to settlement under the Homestead and Preemption acts, and similar land-settlement schemes did much toward increasing this production; but it should be kept in mind that underlying the whole advance of civilization was the rapid development of transportation facilities. With the gen-

11 Niles Weekly Register Vol. 1, 1811.

12 Niles' Register, v. VIII, 1815

13 Report of the U.S. Dept. of Agriculture 1862.

eral use of rail transportation it was no longer necessary to ship the product of the west down the Mississippi. Very soon large cities, which became the terminals for the many railroad lines which were now tapping the western territory, sprang up along the shores of the Great Lakes. Chicago, Duluth, Fort William and Port Arthur became export markets of increasing importance.

During the early part of the 19th century Chicago received large supplies of wheat which found their way eastward, from the western territory. Up to this time trade was conducted without any well defined system and prices quoted were largely based on the private opinions of the buyer and seller. Very often those prices were based on the most scanty and unreliable bits of news. This kind of selling continued for some time but it was very extravagant, and as the volume of business increased it was unable to meet the demands with any degree of satisfaction. The unsatisfactory condition showed the need of some central place where those dealing in wheat could meet regularly to transact business. The result of this was the Chicago Board of Trade which came into existence, in the year 1848.

DEVELOPMENT OF GRAIN EXCHANGES

The idea of meeting at one central place to transact business is not by any means a new one. There are many instances recorded where men have met in some form of organization to negotiate sales and purchases. One of the oldest of these of which we have any definite record was established several hundred years ago at Genoa, Italy. It was the custom there for the buyers and sellers of wheat to congregate around a certain stone at the docks to buy and sell. Later rules for trading were established and finally a building erected which ultimately became known as the Genoa Grain Exchange (14).

Another example of a similar organization is in existence in London, known as Mark Lane. As early as 1285 a certain lane was enclosed behind a house, where a market was established for buyers and sellers to transact business. (15)

14 "Wheat fields and markets of the world"—Rollin E. Smith.

15 Ibid

At several points on the continent exchanges were organized at an early date. The dealers at Chicago, therefore, were not establishing any precedent when they organized the Chicago Board of Trade. Almost from the beginning, however, the farmers of the west began to look with suspicion on the activities of the Board. Whether cause for suspicion really existed is not for me to deal with in an article of this kind. Suffice it to say that the farmers did think that they had just grounds for suspicion; and almost from the beginning they began to make their feelings known. At first discussions were heard around the local elevators which were rapidly being built, or around the store or meeting place in the country districts of the west, and finally the complaints were brought to the attention of the nation through the organization of many farmers' unions or co-operative bodies.

While the inclusion of these organizations in a paper of this kind is not essential, it nevertheless will be of interest to many as illustrating not only the trend of farmers' organizations of the early periods, but as an indication of the discontent which existed among the people of the west; and no small amount of this discontent was caused by, and centered around, the Chicago Board of Trade. Of this reference will be made later.

I give here the names of most of the more important organizations which were established during the latter part of the 19th century. The information has been secured from an article entitled "The Present Farmers' Movement," contained in the Political Science Quarterly, v. VI, 1891. With the list are given brief comments.

The Grange, organized 1867—150,000 members in 1891; A secret organization.

The National Farmers' Alliance, 1880, started at Cook Co., Ill. This order known as "Northern Alliance."

The National Farmers' Alliance and Industrial Union, began about 1875 in Texas, revived in 1880. This became the biggest organization and in 1890 claimed more than 3,000,000 male members.

The Agricultural Wheel, organized in the south in 1882. In 1887 became national body with 500,000 members. This society had its eyes on the capital at all times, believing that 'there in the Capital at Washington have originated the farmers' woes, and from that source alone can come the remedy." (Address of the President of the Alliance, N.C., Aug., 1890).

The Colored Farmers' National Alliance and Cooperative Union, 1886—1,250,000 members.
The Farmers' Mutual Benefit Association, 1887—150,000 members, N.C. to Nebraska.
Supreme Association of the Patrons of Industry, 1890, originated in Michigan, 80,000 members.
National Farmers' League, 1890, New York.
Many other state and local unions or societies.

To indicate the dissatisfaction and feelings that were aroused concerning the Board of Trade at Chicago, the following will be of interest:

> "We demand that Congress shall pass such laws as shall effectively prevent the dealing in future of all agricultural and mechanical productions." — Platform of Southern Alliance, 1889, widely adopted by other societies.

and likewise:

> 1890—Various states ask—'that gambling in products which are articles of food be made a criminal offense.'
>
> Illinois Lodge of Mutual Benefit Association—"Believing that the farmers' products are far below the average cost of production and believing that agriculturists can through their organizations control the market" resolved to request the general assembly of the Grange and the Alliance "to fix the day and date for taking all the cattle, hogs and grain off the market in this month for 20 days."
>
> Chcago Board of Trade a sore grievance to Illinois farmers. Mutual Benefit Association assembly of that state declared it to be 'a den of thieves' and denounced such bodies as 'whited sepulchres, full of dead men's bones'—men ruined by those gambling institutions.

Similar feelings are expressed in an article by Edward W. Bemis, written about this same time. Mr. Bemis says:

> "The farmer feels aggrieved at the supposed forcing down of the prices of his products at the harvest time by large sales by the 'bears' for future delivery of products not at the time in the possession of the speculator" give rise to the Washburn Anti-Option Bill.
>
> Investigations made by the writer do not tend to show this to be true. Prices appear to run fairly smooth. (16)

Notwithstanding the criticism concerning such means of conducting business, we find that during the 50 years following the establishment of the organization at Chicago, similar places for conducting trade have been established in many centers, not only in the west but in what has been known as the middlewest also. Among these are:

Minneapolis Chamber of Commerce.
Duluth Board of Trade
New York Produce Exchange
Kansas City Board of Trade
St. Louis Merchants' Exchange
Omaha Grain Exchange
Milwaukee Grain Exchange
Toledo Produce Exchange
Buffalo Produce Exchange
Philadelphia Produce Exchange
Baltimore Produce Exchange
Winnipeg Grain Exchange.

The system of marketing to which the farmer now has access is so much improved over the conditions of 50 to 100 years ago that comparisons are almost impossible. Had it not been for the extension of railroads westward and the establishment of our present methods of handling grain, it would not have been possible to build up the industry which now exists in that great territory west of the Mississippi and north of the international boundary line. A hundred years ago few people ever imagined that the territory mentioned would become the bread basket of the world; while as recently as 40 years ago grave doubts were cast on the ability of western Canada to produce wheat and other cereals successfully.

Whether the system of sale through grain exchanges is the best system seems at present to be the subject of very much discussion. Few people would have the temerity to say that any existing system of marketing could not be improved.

Whatever criticism may be leveled at the method of carrying on business through the grain exchanges and boards of trade that now exist, it should be remembered that grain under such a system is handled under an infinitely smaller margin than it ever was under the systems which prevailed previous to the organization. It is very doubtful whether grain could have been grown profitably in the west, even with the extension of transportation facilities, had it not been for the cheap and expeditious way in which that commodity has been handled through these central selling organizations.

It is not the writer's desire to leave the impression that the organizations mentioned above have always dealt as fairly with the farmers as they might have done. It would seem from the amount of evidence which has been brought forward at various times that there has been throughout the past justification for discontent, but such conditions are

16 Edward W. Bemis, Univ. of Chicago, in "the Discontent of the Farmer," Journal of Pol. Econ., v. I, 1892-93. p. 201.

inevitable when any group of people look to another to provide the facilities for the marketing of their products.

It is not the purpose of this article to go into details as to the various means of marketing which are now at the disposal of farmers. Throughout the western states and western Canada a huge net-work of modern elevators has been established which make the handling of grain extremely easy compared with the old methods.

A great deal of dissatisfaction has been experienced at times in connection with these local elevators, the feeling being evident to a very large degree that many of these elevators—most of which in the early days were owned by private individuals or companies—were not always giving the farmers justice. To overcome this objection a great many farmers' elevators have been established throughout the winter and spring wheat belts, till now they represent a total running into the thousands. At the present time, therefore, there are few communities in which the farmer has not a choice between a private elevator, an elevator owned by a company which has similar structures at many points—known as line elevators—or a cooperative elevator organization.

Within the past few years another attempt on a large scale has been made to revolutionize our system of grain marketing. Not only have farmers' elevators rapidly extended, particularly in western Canada, but they have gone to the extent that many of the farmers' organizations today are represented on the exchanges and boards of trade.

Behind these several organizations and a number of others of similar nature, there exists a net-work of elevators, either owned by the organization or pledging its grain to it. Everywhere throughout the west one hears criticism of the various farmers' organizations that are established to handle the grain trade. These organizations have met with serious opposition at times from the organized interests, but it is perhaps safe to say that they have met more real opposition from the farmers themselves and, in many cases, at the hands of their own members.

Just what the future of this movement is to be it is difficult to prophesy with any degree of certainty, but it would seem that, with the foundation established in the past 30 to 40 years, there is every reason to believe that the farmers' cooperative agencies will continue to handle an increasing volume of the grain trade of this continent. At this writing, April, 1924, a movement is under way which it is expected will still further improve our marketing facilities for this great crop. I refer to the establishment of "wheat pools" by associations of producers for the purpose of selling this great crop. The objective of such associations is control over a large volume of the crop. Ultimately it is hoped that sales may be made direct to the agencies of, or buyers in importing countries. It is the object of these organizations to sell without recourse to the grain exchanges as far as possible. A number of these "pools" have been operating in the United States but so far they have not had sufficient volume to insure success. Profiting by the experience of their neighbors the western Canadian farmers are out after sufficient volume to give them a voice in the marketing of their crop. In Saskatchewan, where approximately 50 per cent of the Canadian wheat is produced, the objective is a contract of 50% of the seeded acreage to the pool. In Alberta a pool was organized to handle the 1923 crop. Over 40% of the seeded acreage was signed up in this pool and an attempt is now being made to increase the amount. In Manitoba also a similar association is being organized.

While it is not likely that the future can show as great progress in all phases of production and marketing as have taken place in the past, it seems equally true that the last word has not yet been said.

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Vegetational Succession in the Red River Basin.

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The province of Manitoba affords an excellent opportunity for studying plant succession. Until quite recent times the greater part was covered by water,—Lake Agassiz covering all east of the Pembina, Riding and Duck Mountains, and Lake Souris covering the south-western portion. The gradual receding of the water (which is still going on) left a succession of vegetational zones, such as is now being left at the shallow end of Lake Winnipeg, known as Netley Marsh, or Red River Delta. Here can be seen all the stages from lake to prairie. (See Map).

1. The submerged, aquatic plant stage. Algae-Elodea-Potomageton, — Netley Lake.
2. The lagoon-shore-rush stage — Typha,-Phragmites-Scirpus validus,-Gimli, Netley and Balsam Bay lagoons.
3. (a) The swale-grass-sedge stage—Carex-Calamagrostis-Panicularia-Scholochloa-Cinna. Wet most of the summer, first cut for swale hay. or
   (b) Initial Peat-bog stage if pocketed and undrained.
4. Meadow-grass stage, wet in spring, dry in summer—Andropogon-Agrostis-Spartina-Distichlis, (if alkaline) with an intrusion of Hordeum,-St. Andrews Hay Marsh, Benson Hay Lease. See black areas on map of Wild Hay.
5. Willow-dogwood-shrub stage where drainage or elevation is more abrupt. This stage is often the shore or boundary of zone 3, or islands in zone 4.
6. The poplar-scrub preclimax - Poplar - Ash - Willow, association with Viburnum - Cornus, - Prunus inclusion, and Oak where drained.
7. The grass-compositae prairie climax, an ecotone or stress zone between grass and scrub with alternate invasion or retreat, dependent upon the water table or available soil water.
   Wolfberry (*Symphoricarpus*) and Silvery berry (*Eleagnus argentea*) are consocies in this association, - shrub colonies.

These seven vegetational successions can be seen in almost any part of the Red River basin, as in no part has the climax or final vegetation yet been reached. The whole basin is comparatively new,—in fact the most recent formation of the middle west. Over half of it is still partly submerged, and in the initial stage of reclamation by aquatic or semi-aquatic vegetation. Vast areas are marshy or wet grass land and by present rate of drainage these areas soon become potential agricultural land as have the slightly higher parts of the basin. In fact here is where we must expect future settlement, looking for virgin fertility.

And these changes and successions are more rapid than we are prone to realize. It is not long since Lake Manitoba flowed into the Assiniboine. Pioneers on Portage Plains have gone by boat from one to the other and have raised thirty crops of wheat where they

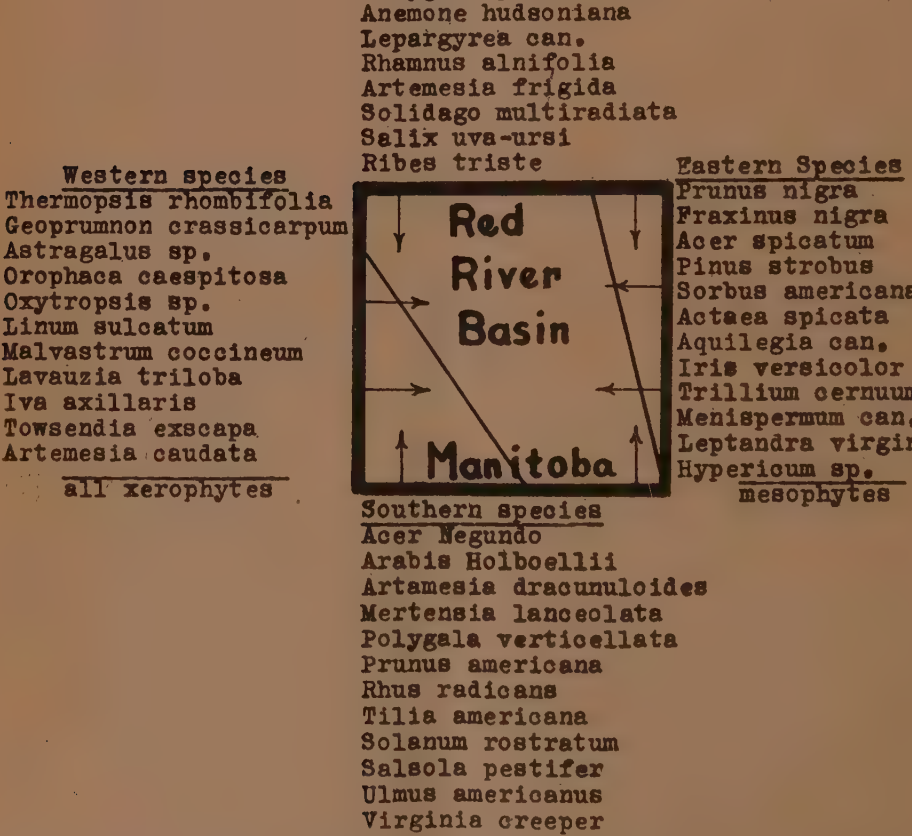
Red River Delta,—showing the seven stages of vegetational succession from lake to prairie. Where the succession is sudden or broken as 2 - 5 or 3 - 6, ruderal weeds take possession of the ecotone, or even of the zone, of sudden transition, a fact sufficient to explain why the Red River basin is overrun with weeds.

once went duck shooting. Now these plains suffer from drought on a dry season.

The duck marshes of today will be the meadows of tomorrow. Some years the lake level drops several feet and this new marsh area becomes a new sow thistle area pro tem, as the sedges and grasses are unable to keep up with such rapid changing conditions and there is a break of several stages in the succession. Hydrophytes are unable to adapt themselves to such sudden changes. This is more or less true of all ecads which have evolved in a stable environment, like marshy land. *Rapid lowering of the water-level always gives a quick succession of mesophytic ruderals like sow thistle.*

This suggests what will happen if lakes are drained and Lake Manitoba could be drained with a few sticks of dynamite. It is one hundred feet above Lake Winnipeg, and the water is held back by a limestone rapids on the Fairford River which drains it. It would be a simple engineering feat to blast out this obstruction and Lake Manitoba would become a vast thistle bed, slowly giving way to sedges and grasses, and to willows, alders and dogwoods as the basin becomes drier,—and then to a slow advance of poplars from all sides. Farming might proceed at any time the land became dry enough, for in these shallow waters the aquatic vegetation has already sufficiently enriched the bottom to give the black humus, characteristic of the Red River gumbo.

Under present conditions this Lake will continue to recede steadily as it has for some

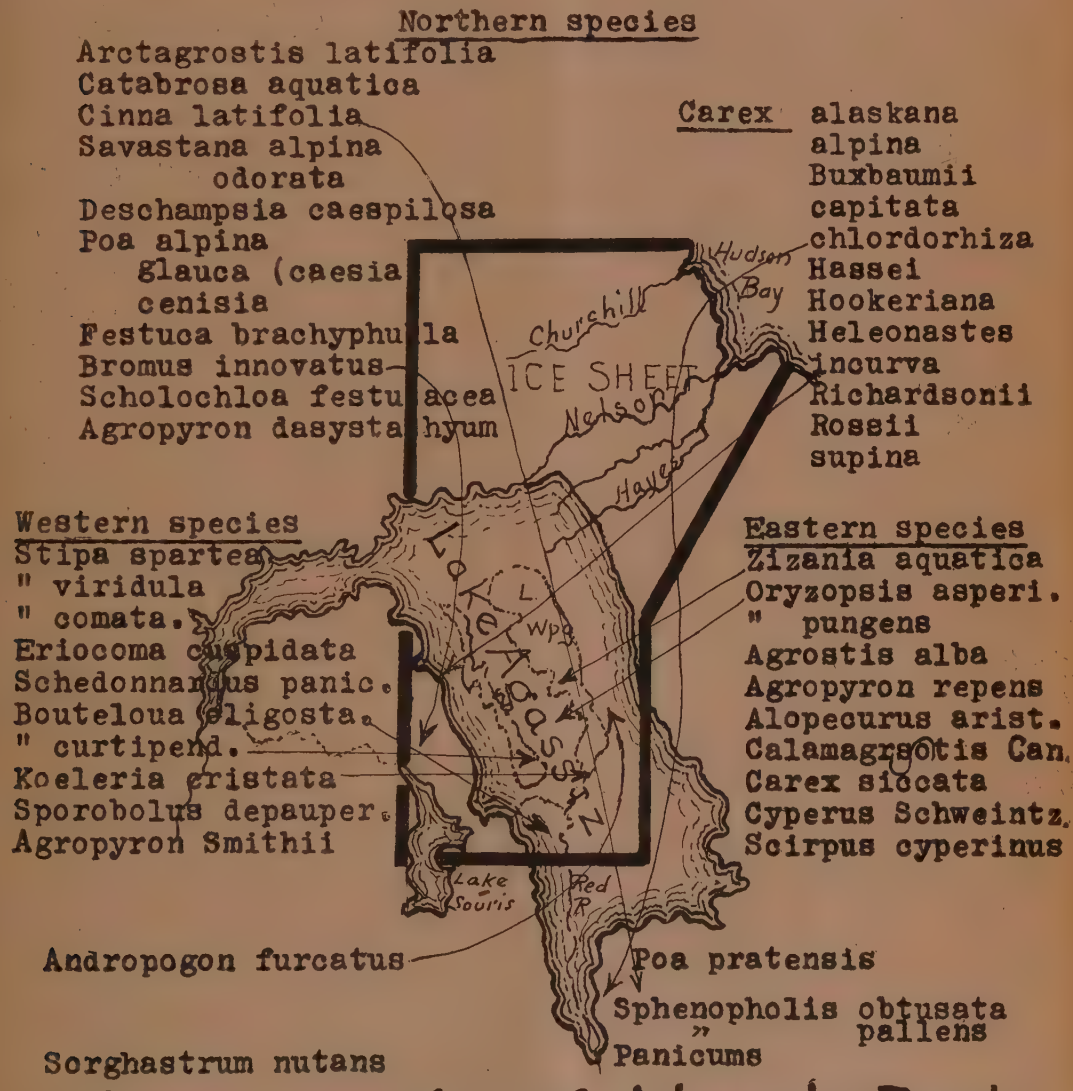


Boundary species which have comparatively recently entered the province. Only the northern, eastern and southern species are indigenous to the Red River Basin.

time past, scarcely giving time for biotic reactions that make for the normal seven vegetational successions as found at the head of more stable Lake Winnipeg, where they are closing in on all sides in an orderly and successional manner. (see Map).

That this is the way the whole basin and the greater part of Manitoba got its vegetation is proven by the fact that our flora is composed of Northern, Eastern, Southern and Western species and in about equal proportions. Of our grasses 14 are decidedly northern, 12 are eastern; 20 or so southern and 16 western. *Poa pratensis* has invaded the Red River Plains during the past century, for Douglas collecting at Winnipeg in 1827 makes no mention of it, and its present rapid spread would lead one to think it is the natural climax grass for the Red River basin.

With this sequence of succession established, it would be interesting to know the age and the time of each for any one area. As



Grass Invasion of Agassiz Basin

this depends almost entirely upon the water-table in a hydrosere such as this in the Red River basin, the age of each succession will vary with the rate of drainage, and this we are unable to determine for the past, except by the layers of alluvium or clay as exposed by excavations or the erosion of the Red River. These layers average about fifty to the inch, and the black humus content would indicate the remains of initial and medial seres of aquatic and semi-aquatic plants. Each must have had periods of floods and recession to account for the oxidation and decay of the vegetable matter for one looks in vain for stem remains of hydrophytes in these layers, only the top layer has any. This leads us to speculate on how recent is the present invasion of trees into this Red River prairie. We find no stumps or twigs in the subsoil or even in the surface soil, and the oldest trees on the plain level are less than a century. Only on river banks do we find older trees, and a century is not the life of oak, elm, ash or popuar, in this latitude for specimen trunks in the college museum from the higher slopes of the Riding Mountains, are,—

Oak (*Quercus macrocarpa*)	216 years
Ash (*Fraxinus viridus*)	149 years
Spruce (*Picea alba*)	143 years
Tamarac (*Larix americana*)	132 years
Black Poplar (*Populus balsamifera*)	97 years
Birch (*Betula lutea*)	92 years
Elm (*Ulmus americana*)	80 years
White Poplar (*Populus tremuloides*)	81 years
Manitoba Maple (*Acer Negundo*)	54 years

As these specimen trees are naturally the largest that could be found, these ages may be taken as fairly representative of the maximum age of these trees in latitude 52, altitude 1000 - 2000 feet, rainfall 20 inches These ages have only been attained in the altitudes above the old shore lines of Lake Agassiz which are about the 1000 foot line. The age of the present poplar bluff on the Red River plains is less than seventy years.

And this seems to have been the initial tree invasion along the Red River, despite traditions of earlier, destructive prairie fires. The Indians were burning off the old grass to allure the buffalo to the new. Such fires would, of course, have destroyed trees, but where are the stumps? The charring would have preserved the stumps. The maps of LaVerandrye and other early explorers of this region show trees only along streams and rivers. Their records suggest treeless plains. David Douglas, collector for the Royal Horticultural Society of England came up the Red River 1827, and remarks about cattle pasturing along the river, and riding out to White Horse Plains in July when the water extended four miles back from the river, and the vegetation recorded indicates a hydrophytic stage, which is now mesophytic. The grasshopper plagues of Selkirk settlement days, and the stories of pioneers watching the buffalo hunters disappear across the plains all point to nearly treeless prairies a century ago.

The same is true of the Lake Souris basin. Within the memory of living pioneers it was quite treeless west of Brandon, and farmers often remark how the trees are spreading around Hamiota, Virden, and Souris and all the lower region within the Lake Souris basin.

A great part of the Red River basin is, therefore, just emerging from a meadow-grass and shrub-island stage, and entering upon a poplar-shrub preclimax. In this new "park country" as it is called locally, many stands of poplar are less than forty years, and there is no evidence of older trees. The average age of the present stand of poplar along the Red River is 30 years, and in most recent formations there have been no prisere or previous stand.

The future of these areas will depend upon rainfall and drainage and the secondary influence of cultivation, and settlement, but everything points to a Poa-Symphoricarpus-Compositae poion, as the Red River dryland prairie climax, rather than a deciduous hardwood forest climax as in most valleys. Of course, the Red River basin is not a valley. It is an alluvial plain which has rapidly drained and cut through by a river, ladened with sediment. The river has never wandered from its present course or reacted upon the plain in any other way than by drainage. By sinking and widening the Red River has now passed beyond the flooding stage.

The present vegetational zones are very unstable, but age, aggregation and invasion will give control of habitat, and tend to stabilization as will also, the increase of the dom-

inant vegetation. Dominance is due to reactional control of a community for a period. Initial stages are always transient and final stages more permanent and stable. The initial or lower stages of vegetation as rushes, reeds and sedges have no sharp line of demarcation,—no ecotone,—no stress area of transition, or dovetail struggle as between grassland and woodland. Prairie fires favor grass formation by the destruction of scrub, and a succession of fires may keep a prairie in a grassland subclimax. This was as the Indian had it in buffalo days. Settlement checked the fires and permitted the advance of scrub and woodland on to the prairie or vacant land, and over half the land is vacant.

Plant succession is due to the progressive change of basic factors culminating in a stable vegetation. Plants are, therefore, our best indicators of all those conditions that make for plant growth, climate, soil, drainage, slope, fertility, available plant-water, light, atmosphere, exposure, the present stage of plant development and the future possibilities.

This suggests the value of a careful plant survey as a means of determining the vegetational adaptibility of an area independent of soil analysis for we may have a fairly uniform vegetational formation of uniform-possibilities on a variety of soils as we have on the Portage Plains. That sum-total of life relations as we find them in a plant association, is a bigger factor in plant growth than the top stratum of soil that holds the plant erect. There is, therefore, much need of more ecological work in Canada, particularly in newer areas where normal, virgin conditions indicate the sequence of plant succession, and where future available and valuable land will be open for settlement. The map showing the present native hay areas, gives an idea of the amount and location of such land, and according to this 378,000 acres will soon be available as rich agricultural land in the Red River basin.

A second article will consider a "Standard Method of Plant Survey for Agricultural Forecast." The appended list of ecological terms as used by American ecologists is a preliminary step towards adopting this American method of plant survey.

Explanation of Map on Our Wild Hay Areas.

(See Page 306)

The oblique lines represent the Kentucky Blue Grass invasion in the Red River Valley: the horizontal lines represent the bunch grass plains,—Spear Grass and Buffalo Grass dominating: the vertical lines represent swale hay areas,—reed-grass, and sedges predominating, —548 sections or 378,000 acres cut for wild hay.

ECOLOGICAL TERMS USED IN PLANT SURVEY

by

Clements, Weaver, Shantz, Transeau, et al.

Relating to Adaption

Ecology—The study of the plant in relation to its environment.

Ecotone—The stress line or competition area between two plant associations, as the margins of woods, etc.

Ecesis,—The germination and establishment of invaders.

Ecize,—To adjust itself or fit in with new conditions.

Adaphic—The influence of soil upon plants

Epharmonic—The influence of sun and drought upon the plant.

Ecad—A habitat form due to origin by adaption.

Relating to Water Supply

Holard—The total water content of the soil.

Chresard—The available water of the soil, the physiological water content.

Echard—The non-available water of the soil.

Relating to Succession or Sequence

Sere—A unit of plant succession.

Hydrosere—Succession in open water to a climax vegetation.

Geosere—The total plant succession of the geological past.

Subsere—A partial development of a climax of stable vegetation.

Prisere—The previous development of a succession.

Initial stage—The beginning of a vegetation area.

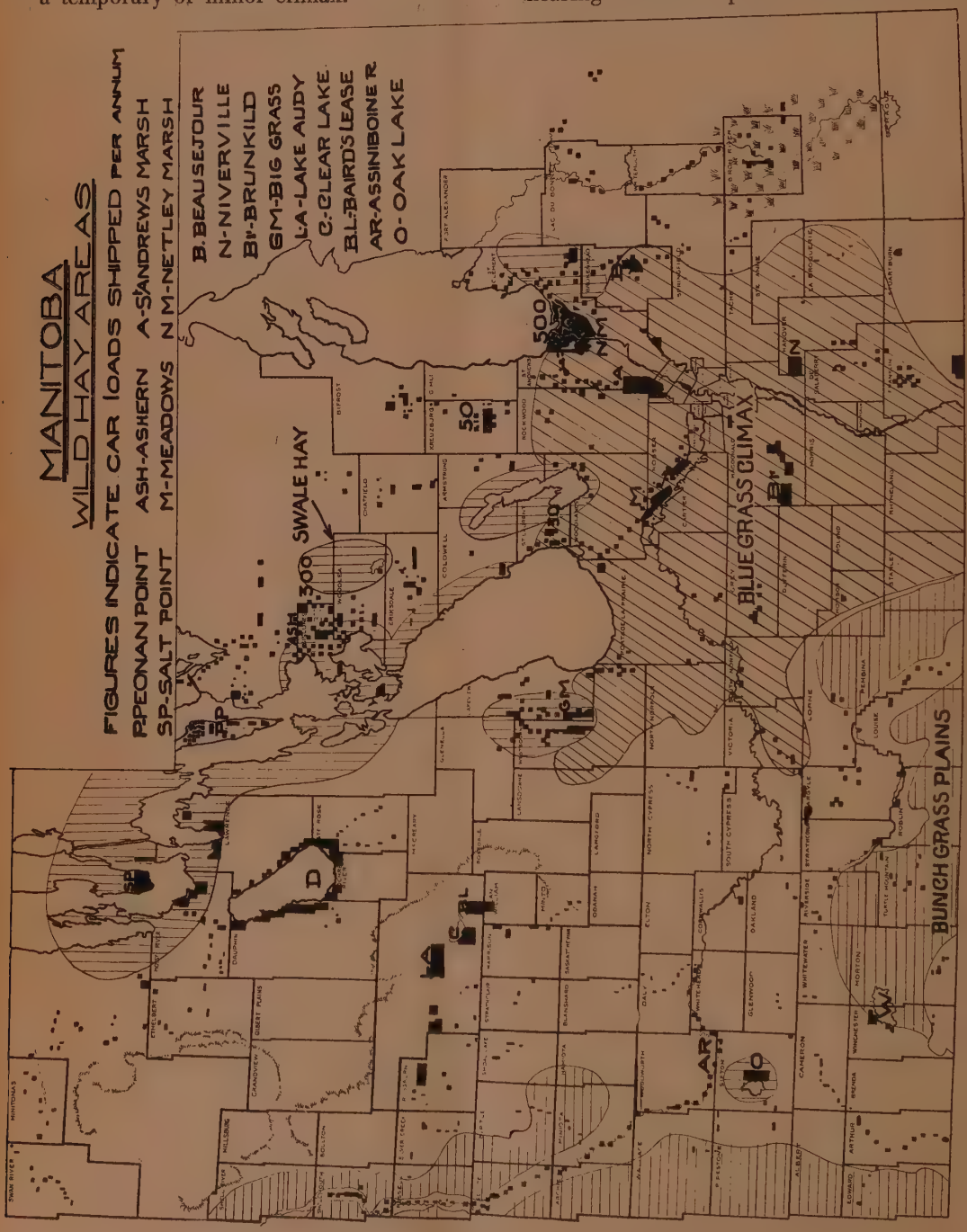
Medial stage—Any changing, unstable association from start to climax.

Climax—The end of a progressive succession; the final or stable vegetation of an area.

Subclimax—An incomplete cycle of change; a temporary or minor climax.

Postclimax—A second climax due to increased water supply or a Northern exposure.

Preclimax—An early climax due to decreased water supply, or Southern exposure, nearing full development.



Relating to Quality or Prevalence

Dominant—The chief constituent of a plant association.

Subdominant—The second species in point of numbers in an association.

Co-dominant—Sharing dominance with another species—a rare occurrence.

Relating to Spread and Migration

Germules—The seed or germinating means of survival.

Migrules—Migration means of survival.

Propagules—Root spreading means of survival.

Relating to Association

Socies—A tolerant species—A social plant—forming societies.

Consocies—Mutual groups of plants capable of thriving in one association.

Formation—An association of plants of similar habits and environment as,—a prairie,—a forest, etc.

Secondary formation — Those which have arisen through human interference.

Closed formation—So crowded that further invasion is difficult.

Complimentary society—Rooting at different levels, and not competitive.

Relating to Societies

Composile—A society of plants characterized by Compositae.

Asterile—A society composed mostly of asters

Psoralea-Helianthile—A mixed society of silver clovers, sunflowers, gaillardi, and cone flowers.

Clan—A secondary or local group within a society or climax community.

Colony—A pioneer group on a bare area or an invading group of species.

Communities—A habitat area of one or more societies or consociations.

Gentianare—A clan of Gentians.

Fragarien—The lower or strawberry layer.

Thalictren—The higher or Meadow Rue layer.

Species—Socies, Consocies, Associes, — terms to show increasing mutual complexity or tolerance of units.

Clan—Colony, Society, Consociation, Association, Community, Formation—terms for larger and larger groups, and based on sequence or succession.

Scirpus - Typha - Phragmites—Is a consocies in a reed-marsh association, because of regular successional occurrence.

Biotic—A reaction due to plants or animals.

Relating to climax Vegetation

Hylion—Forest climax.

Dryon—Scrub climax

Halion—Alkaline scrub.

Helion—Swamp scrub.

Poion—Grassland climax.

Populus - Salix - Cornus helion—a Red River wet land sub climax.

Poa-Symphoricarpus-Compositae poion—Red River dryland prairie climax.

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Some Trends in Soil Microbiology.

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That branch of science which deals with the microscopic life of the soil may be said to be still in its infancy. Despite the fact that well over sixty years have elapsed since Pasteur's first epoch-making discoveries were made, bacteriology, as applied to soil phenomena, has not developed to anything approaching the same degree as it has applied to other fields. The reason for this is to be found largely in the nature of soil itself. When the pioneers of bacteriology first hinted at the rôle which bacteria play in many of nature's processes, attention was centred almost exclusively upon the relationship of bacteria to human disease. Medical bacteriology offered the most alluring field for research, and held out the biggest reward for the investigator with the result that it soon dominated the entire science. In this field progress has been remarkable, due to the impetus given by the researches of Pasteur himself and of the other brilliant scientists who devoted their energy to the study of disease bacteria. Accordingly, even today, when the many-sided activities of bacteria are better recognized, in the lay mind, and to a large extent among the medical profession, bacteria are synonymous with disease, this despite the fact that of the hundreds of species now known but two score or so can be held at all responsible for human or animal disease.

The immediate application of bacteriology to medicine was, if anything, detrimental to the development of the science as a whole. The objective study of bacteria and their activities was delayed or made at best slow progress. Now, to-day, when more workers are beginning to devote their attention to bacteriology other than medical, much fundamental work, dealing with the activities and behaviour of bacteria as bacteria, remains to be done before soil bacteriology may benefit agriculture to anything approaching the same extent that medical bacteriology has benefited medical science.

By reason, then, of the urgent need of the search after fundamentals, soil bacteriology, or microbiology as it is more aptly termed, is still in its early stages. Dairy bacteriology, receiving a stimulus from the close relationship of milk to public health, has so developed that modern dairy practice is directly based upon our knowledge of the activities of bacteria in milk and dairy products. Here bacteriology has created a revolution. On the other hand, the direct application of soil bacteriology to farming methods is as yet exceedingly limited; no radical change in soil management has so far resulted.

That soil bacteriology, therefore, is not an applied science to the same extent that dairy and medical bacteriology are applied sciences is due firstly to the fact that but few workers considered soil to be worthy of study, and secondly to the infinite complexity of soil itself which renders much preliminary fundamental research in pure science indispensable.

When it was suggested by the work of Pasteur himself that purely chemico-physical processes were insufficient to explain some of the changes occurring in soils a few investigators, deeming soil not unworthy of study, with their pioneer work laid the foundations of soil bacteriology. Hence some of the fundamental discoveries, dealing almost entirely with the relation of microorganisms to the nitrogen supply of the soil, were recorded in the last three decades of the past century. As early as 1877 the biological nature of nitrification was established by Schloesing and Müntz (37), though it was not until 1891 that Winogradski (46) succeeded in isolating the organisms concerned. The next decade saw the classic researches of Hellriegel and Wilfarth (19) into the function of the nodules of the Leguminosae, accompanied by the isolation in 1889 of *B. radicicola* by Beijerinck (1). In 1893 Müntz and Coudon (32A) showed that ammonification in soils was likewise a biological process, while the groundwork of our knowledge of non-symbiotic nitrogen fixation was laid by the researches of Berthelot (3) Winogradski (47, 48), and Beijerinck (2), the last of whom discovered *Azotobacter* in 1901.

Following upon these pioneer discoveries came investigations into methods of soil analysis, and it was perhaps natural that most of the earlier work should have centred round soil processes involving changes in nitrogen. Much attention was given to developing methods of technique which should serve to measure the numbers of bacteria in soil and, what is of more importance, their activities. With the development of the gelatine plate method of Koch for the isolation of bacteria in pure cultures came its adoption as a means of estimating numbers, and to-day, with all its inherent faults, this is still the most widely used method for obtaining comparative figures as to the number of bacteria in a sample of soil. Total numbers derived from plate cultures, however, when applied as a gauge of the productivity of the soil, were soon recognized as being of so little value that a search was made for some method which would be a measure of the activity of the bacteria concerned in the various soil processes

The methods devised were planned to measure bacterial activity as related to ammonification, nitrification, nitrogen-fixation and denitrification. Brought out a score of years ago these methods have been in general use up to the present time. A medium, specially prepared to favour the particular process under investigation, is inoculated with a definite amount of soil to be tested. After the lapse of some arbitrary period of time the amount of change which the nitrogenous constituents have undergone is determined by chemical analysis. Deductions are then made as to the efficiency of the soil itself respecting the particular process. This method of favouring specific physiological groups was devised by Remy (33) in 1902, and developed by later investigators, chiefly by Löhnis and co-workers (23, 24, 25, 28, 29, 30). Other workers have attempted further modification of this method by using soil as a basic medium instead of the solutions of the former workers, without effecting, however, any noticeable improvement. The objection that the medium to which materials were added to favour particular group development did not correspond to the original soil was valid in each case.

Although the plate method of determining the numbers of bacteria in soil and the physiological grouping method of measuring their activity have been universally employed yet serious defects in both have long been recognized.

Colonies developing on gelatine or agar plates reveal only a fraction of those organisms known to live in the soil. Organisms of the nitrifying and nitrogen-fixing groups, the important groups of cellulose and sulphur organisms all fail to develop upon ordinary media as used for making quantitative determinations. Even the relative value of such plate counts is not yet proven, for we have no assurance that a total increase will be reflected in an increase in the plate count. This would not be the case should an actual increase be confined to those groups, such as just mentioned, which do not appear on the media employed. Indeed, in view of the intricate systems of symbiosis and antibiosis, conditions might conceivably arise under which the plate count might vary inversely with the actual totality of organisms present in the soil.

With our method of plate counting, moreover, we have no means of knowing which of those forms developing upon the plates lead an active life in the soil. Many organisms growing on ordinary plate cultures appear to assume an exaggerated importance. This appears to be the case specially with the spore-forming bacteria which, as has been pointed out by Conn (12), and also by Joffe and Conn (21), appear to exist in the soil largely in the resting state. Former studies by Conn (8, 9) point to the assumption that they are of much less significance in normal soils than formerly regarded. In any case the plate method gives us no clue as to which forms are active in the soil.

The same type of objection applies in the case of the physiological group method of estimating the activities of soil bacteria. Here we are confronted with the difficulty arising from a failure to duplicate soil conditions *in vitro*, and have consequently no right to interpret results as representing correctly soil processes. Ammonification methods are especially faulty. Apart from their measuring accumulation rather than production of ammonia there is much to indicate that ammonification under laboratory test conditions is brought about, partially at least, by organisms which in the field are for the most part

inactive. The work of Joffe and Conn (21) indicates that spore-forming organisms, such as are capable of strong ammonification *in vitro*, are inactive in soil under ordinary farm practice conditions. Large amounts of nitrogenous organic substances such as used for laboratory experimentation may induce the vegetation of spore formers.

Much the same type of objection holds for our common nitrification and nitrogen-fixation methods, where the addition of relatively large quantities of ammonium salts or of soluble carbohydrates means a radical departure from conditions prevailing in the field. There is, however, less likelihood of the organisms concerned being different under artificial and natural conditions, for we are here much more restricted as to species. What these time-honoured methods do teach is that under a certain set of conditions bacteria from one soil may be more active than those from another. Russell (35), in referring to nitrification says:—"The experiment in culture media measures the rate of nitrification under the circumstances of the experiment; the accumulation of nitrate in the soil, on the other hand, measures the rate of ammonia production."

Much difficulty has been encountered in interpreting laboratory results in the light of experience in the field. The discrepancies which show may be due not only to inherent defects in laboratory technique, but also to a lack of understanding of the actual limiting factors in the field which may or may not be biological in nature, and also to a failure to consider microorganisms other than bacteria.

One noticeable tendency in present day investigations is a recognition of the fact that microorganisms other than bacteria must be taken into account in soil biological studies. An epoch in soil biology was marked by the first researches of Russell and Hutchinson (36) at Rothamsted in 1909 on the effects of partial sterilization of soil. The evidence they presented strongly pointed to a factor present in the soils under investigation which was inimical to bacteria, biological rather than chemical or physical. It was furthermore found that the presence or absence of this limiting factor coincided with the presence or absence of protozoa. This led to the foundation of the protozoa theory of partial sterilization.

This pioneer work was quickly followed up by investigators elsewhere. Although certain workers, chiefly in America, maintained that the theory was untenable, the work of other investigators such as Cunningham and Löhnis (13) lent it further support. In the meantime workers at Rothamsted have been gradually accumulating much data in support of the pioneer work. Answering the objection that protozoa are present in normal soils only in the encysted or inactive state, Martin and Lewin (32) discovered a method for demonstrating the presence of active forms, while Cutler (14) devised a method for estimating the numbers of active and inactive (encysted) forms. Although the protozoa theory is not universally accepted yet such a mass of data has been brought forward, especially by the Rothamsted workers, that it represents, for some soil types at least, the most probable explanation of the known facts. Some of the most recent observations of Cutler, Crump and Sandon (15) indicate a balance between certain groups of protozoa and bacteria such that inverse rhythmic variations in the respective numbers are determinable, not only by seasonal, but even by daily observations. The precise limiting rôle of protozoa in normal soils is probably obscure. In a recent series of contributions Waksman and Starkey (44) emphasize the importance of a better understanding of the behaviour of fungi and actinomycetes and of the changes in the nature of the bacterial food supply following partial sterilization before attempting to explain the limitation of the bacteria presumably due to protozoa.

Fungi were formerly thought to be abundant in acid soils, and of little or no importance in neutral or well-limed soils. Recent investigations have shown that they are abundant in all normal soils, and constitute a biological group which must be reckoned with in coping with soil fertility problems. Our knowledge regarding the part fungi play is as yet very meagre. Most of the work so far has been qualitative in nature, consisting in descriptions of isolated species. Physiological studies with pure cultures indicate that soil fungi (under certain conditions at least) are capable of participating in many activities formerly thought to be the exclusive work of

bacteria. Methods of estimating numbers, and other quantitative work done so far are only approximate, due to the handicap of unsatisfactory technique which allows us but an imperfect glimpse of what fungi actually do in the soil. There does appear no doubt that fungi are to be reckoned with as active participants as regards such processes as ammonification and organic, and specially carbohydrate decomposition.

Soil actinomycetes are likewise being regarded as an important group of soil organisms and, as in the case of fungi, our knowledge is only beginning. Much of the knowledge we do possess is due to Kranisky (22) Conn (11) and Waksman (38, 39, 40) also in collaboration with Curtis (42) and Joffe (43), and quantitatively, at least, this group of microorganisms appears to constitute an important part of the soil microflora. Conn found actinomycetes constituting 12 to 50% of the colonies on soil plate cultures. At Ottawa, regular examinations of soil during the winter have shown this group to comprise at 2 inches depth 21 to 37% of the colonies, at 6 inches 27 to 39%, and at 10 inches 28 to 50%. The optimum temperature for growth is higher than that of the majority of soil bacteria, while further study indicated that their activity was suspended in winter soils. Under certain conditions at least, actinomycetes have been shown to be active in bringing about chemical changes in soil including the decomposition of cellulose.

Algae have been recognized as being present in normal soils but so far little precise information is at hand regarding the extent of their activities as effecting physiological processes in the soil. There is an indication that in the surface layers at least, they are able, as chlorophyll-bearing organisms, to aid nitrogen-fixation by manufacturing carbohydrates to serve as supplies of energy for Azotobacter. At lower depths, removed from the sunlight, this function would naturally cease, and it would appear that in this case algae would assist in conserving nitrogen by the absorption of soluble nitrogen salts which would be converted into protoplasm.

Finally the prospect of an ultramicroscopic soil flora presents itself. In this regard we are completely ignorant, but must recognize the possible existence of invisible organisms capable of influencing soil processes directly in themselves, or indirectly by affecting bacterial life. While Rossi (34) reports negative results as to the presence of invisible germs, yet Dumas (16) found in a sample of earth bacteriophages which were active against *B. coli* and *B. dysenteriae* (Shiga). While the presence of the bacteriophage may have been due to contaminated soil, yet the results point to a wide field for study, and suggest the possible presence of ultramicroscopic germs affecting soil processes indirectly by limiting bacteria in the capacity of bacteriophages. That this appears to be the case with the legume nodule organism is indicated by a recent communication of Gerretsen, Gryns, Sack and Söhngen (18) who report the isolation of a bacteriophage specific for *B. radicicola* from certain legume nodules and also from a few soil types.

Apart from the better recognition of the part which microorganisms other than bacteria play in the biological processes in the soil, another trend is seen in the tendency to attack bacteriological problems from a new angle, using the organisms themselves as a starting point. As Conn (8) puts it, in introducing a series of soil flora studies, this type of investigation starts with known organisms, and is directed towards their unknown functions, in contrast with the usual physiological group method which starts with a known function (nitrification, nitrogen-fixation, ammonification, etc.) and is directed towards the unknown organisms. This type of soil survey of the microflora is necessarily all-embracing, including organisms other than those directly concerned with the nitrogen cycle. Work of this type, initiated largely by Chester (6) and developed specially by Conn (8, 9, 10, 11) has given us some insight into the nature of the general soil flora, and has helped to revise many prevailing ideas regarding the relative importance of certain groups of organisms in nature. Of importance in connection with objective studies of this nature should be mentioned the researches of Löhnis (26) also in collaboration with Smith (31) into the morphology of bacteria. Their investigations indicate that the life-cycles of bacteria are much more complex than previously thought to be the case. Further work on soil flora, by enlarging our knowledge of the numerous units of the soil

population with respect to their diverse functions, their various conditions of antibiosis and symbiosis, must eventually pave the way to a fuller understanding of those processes of nitrogen transformation, so important in soil fertility.

A development of this type of research will include a knowledge of the relationship of systems of cropping to the soil microflora; the actual bearing of crop production upon predominating bacterial types. As yet practically nothing has been done in this direction apart from very general considerations. It is true that attempts have been made to correlate crop yield with physiological efficiency as expressed by the amount of ammonification, nitrification or nitrogen-fixation measured under empirical laboratory conditions. Examples of this are shown in much of the Rothamsted work, in studies by Brown (5), Gainey and Gibbs (17) and Waksman (41) and represent lines of investigation which help to place the subject on a more practical basis. There is some indication that work such as this will yield us a biological method of measuring soil productivity. In this connection the type of growth of *Azotobacter* has been used by Christensen (7) as a means of measuring lime requirements, but, as pointed out by Löhnis (27), the simpler method of measuring the hydrogen-ion concentration furnishes approximately the same information. There is, however, need of a method, necessarily biological or biochemical, which will be an indication of the ability of a soil to produce crops.

With so many problems of fundamental discovery rather than immediate application waiting for solution, it is but natural that our present day technique should be inadequate. Greater than the urgency for standardization of technique is the need for improved, more accurate methods. With our faulty methods of obtaining even approximate numbers or approximate measurements of function we are much handicapped. A direct microscopical method for soil examination is needed which will prove as useful as that devised by Breed (4) for milk examination. The infinitely greater obstacles in the way of a successful method in the case of soil are evident from the nature of soil and the difficulty of making organisms visible. A method devised by Conn (12) and further developed by Whittles (45), though harboring many imperfections, has been a distinct step forward, and has proved of value in disclosing something regarding the condition in which certain bacterial types exist in the soil. One apparent obstacle in soil studies has always been the impossibility of obtaining a sterile soil for pure culture work chemically and physically unchanged by the sterilization process. It may be that this will force soil bacteriologists to concentrate more on problems of impure cultures and associative action. Hastings (20) has recently indicated the value of paying greater attention in bacteriological problems to the question of impure cultures, to work with which has been, as he says, repellent to the bacteriologist. A new mode of attack on soil problems may be suggested, for nowhere than in soil are the physiological changes more evidently the net result of a host of intricate associative actions.

It may be said that in the main, applied soil microbiology must wait for more light of a fundamental nature as yielded by purely scientific study in microbiology and biochemistry, for practical science can only go as far as pure science will let it. Results which in themselves may appear to be of no practical value contribute none the less surely to our better knowledge of the soil, the prerequisite to a proper and useful application.

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The Recovery of Potash from Kelp.

A Review

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Before considering the problem of extracting potassium from kelp, it would be interesting and instructive to review the potash situation in the United States and Canada.

Prior to 1915 the Germans held a monopoly on the world's supply of potassium. Like most people who have a good thing and do not realize it, they lost this monopoly due to the activities of American brokers who invested in mines in Germany and sold 80% muriate of potash for $21.00 per ton, which had been selling regularly at $38.00 per ton to the American farmer.

If certain accounts can be credited, (1) we are fairly well assured that the potash business in Germany was remunerative enough to warrant a regular propaganda system to discourage any attempt to seek potassium in our own land. Capital, of course, was afraid to invest in doubtful Eastern deposits because it was uncertain about the methods of extraction as applied commercially and also about the competition from the German fields which it would have to meet. The geography and extent of our holdings here discouraged any attempt to haul overland the more crude material to be found in the West and uncertainty again frightened capital when it considered establishing large plants for the recovery of potassium so far from the source of demand.

The reorganization of the German Syndicate caused an export duty of 100% to be placed on mines not entering their syndicate, which shipped out more than one-half the total product from Germany. The result was a rise in price of potash in the United States and Canada, until the Hill-Taft settlement followed which reduced the price again to around $38.00 per ton of 80% muriate of potash. This price obtained until the war stopped the exportation of potash from Germany. The American people were thus cut off from their natural supply and, due to the uncertainty of how soon the war was to end, capital still refused to develop home industry, because the government would not give a guarantee to protect that home industry, should the war end and the normal trade be resumed. Consequently little was done in regard to manufacturing, but a large amount of investigation was conducted in regard to source and availability of potassium in potassium compounds.

It is argued that Germany is selling her potash to American fertilizer companies for $37.00, which is in turn retailed to the farmers for $52.00, thus allowing the companies $15.00 per ton for the accommodation. The price is such that the government in guaranteeing protection for five years would not be required to ask the farmers to pay much more for their home-manufactured potash. Then why not make a small sacrifice and put our own industry on its feet?

There have been many methods suggested to relieve our dependence upon foreign countris in regard to our demand for potash, but perhaps none has created such an interest as the possibility of extracting potash from kelp. That sea-weeds contain a large percentage of potassium chloride and iodine has long been known, and in some instances the weeds or their ashes have been used directly applied to the land as a mineral and organic fertilizer. The term "kelp," formerly applied in Scotland to the ashes of sea weeds, has now come to mean any of the brown marine algae. However, in some cases the meaning has been restricted to the giant varieties of sea weed in the various oceans, the two most important of which are *Macrocystis pyrifera* and *Nereocystis luetkeana.*

Nereocystis, an annual (2) often attains the length of 50 feet in a single growing season. It is found in localities of heavy surf and tideways, most frequently clinging to a rocky bottom with the end of its long rope-like root, termed a "hold-fast". The root proper, often called the "stipe", is a long cord-

like tissue, bound together by woody fibres that develop into a hollow tube as it nears the heart of the plant. The stipe terminates in a large ball-shaped arrangment called a "pneumatocyst" which is hollow and filled with air. This allows the plant to float near the surface. Extending from the top of the pneumatocyst are two fronds or leaves, each about 15 feet in length which wash or trail out in the current. This fact makes the harvesting of these algae a comparatively easy matter as most of the plant can be recovered by clipping a few feet under the surface of the water.

Macrocystis, (2) on the other hand, is a perennial, which grows to about 100 feet in length and like the other, it grows in a swift tideway or rough surf on a rocky bottom. The only difference between the morphological appearance of this plant and that of *Nereocystis* is that instead of one stipe it developes many and the fronds are distributed along the entire length of the stipe. The largest of the fronds occur at the bottom and they decrease in size toward the upper or surface end of the plant. Each frond is attached to the stipe by a short stem which is connected to a pneumatocyst, and as the plants grow in length the pneumatocysts cause it to float upon the surface. However, this type must necessarily retain a large amount of its structure near the bottom.

The reproduction of these plants is effected by numerous sporargia which develop spores. The sporangia are developed on the fronds near the bottom and the spores are cast on the rocks where they germinate and quickly anchor themselves, thus giving rise to new plants.

Although these plants are able to withstand considerable hard usage by tide and storm, the beds are usually thinned out during the hard winter storms. However they most accommodatingly leave their spores behind in time to produce a fresh generation the following summer for the harvesters. The consideration of propogation is really serious, because if harvested at the wrong time the spores will not be shed in time to produce the next crop.

Harvesting a grove of *Nereocystis* can only be accomplished once a year, because by cutting below the surface nearly the entire plant is recovered. With *Macrocystis* it is different, because of its difference in growing habit. Only the tips of the latter are severed in the harvesting and the clipping tends to produce a stooling effect, thus giving a thicker, more productive bed for the successive harvests. It has been found that the time required for the second growth is from 40 to 60 days.

Occurrence of Kelp (2)

The two most important species are found in scattered groves along the Pacific Coast. Extensive groves are also found along the southern and western coast of Alaska, also around the vicinity of Kodiak Island. All of the important groves from the Mexican Boundary to Puget Sound have been measured and mapped to scale, also the important groves in Alaska. During the last three years, enough work was done in making surveys to allow a rough estimation of the amount of kelp in the various fields. The groves naturally and accommodatingly have distributed themselves around good harbours, the most important of which are Puget Sound, Santa Barbara, San Pedro and San Diego. In Alaska the stations are Ketchikan and Kodiak.

The Puget Sound groves alone are estimated to yield 390,000 tons of wet kelp per year, while in South Eastern Alaska around 70 square miles of groves have been surveyed and mapped—calculated to yield 8,000,000 tons of wet kelp per year. Of the total amount of groves surveyed it is estimated that 2,880,000 tons of wet kelp are easily available, being situated in quiet water without obstruction to navigation.

Composition of Kelp (2)

Tables I and II give the composition of some samples of *Nereocystis* and *Macrocystis* from the various groves, as determined by the United States Department of Agriculture.

TABLE I. COMPOSITION OF NEREOCYSTIS

(Dry Basis).

	%K_2O.	%I_2.	%N.	%Organic Matter
Fresh	18.04	.23	2.26	51.13
Water	17.61	.24	2.21	51.11
Bay,	31.62	.25	1.21	33.15
Puget	16.92	.20	2.57	51.16
Sound	17.05	.24	2.71	51.67
	17.32	.28	2.53	54.12
Bay of	16.96	.02	2.15	57.25
Monterey,	23.82	.17	2.41	47.26
Cal.	21.76	.18	1.58	50.20
San Juan	25.7	.08	1.29	41.80
County,	13.3	.15	2.52	61.5
Wash.	23.0	.17	1.32	46.2
	16.2	.15	2.32	35.30
Geese	28.26	.06	1.06	43.52
Is., Alaska	15.44	.14	2.27	56.25
Wrangell	24.8	.03	.98	42.78
Straits	28.76	None.	.59	32.66
Alaska	26.65	.1	1.46	43.78
	22.73	Trace.	1.54	—

TABLE II. COMPOSITION OF MACROCYSTIS

(Dry Basis).

	%K_2O.	%I_2.	%N.	%Organic
LowPoint,Wash.	12.80	.23	1.37	59.40
NeahBay,Wash.	19.6	.2	1.81	51.50
Monterey Bay,	18.3	.26	2.32	57.00
Cal.	12.38	.18	2.11	68.80
Point San.				
Luis, Cal.	8.62	.14	2.35	68.26
Pt. Conception,				
Cal.	14.17	.24	2.15	62.95
Pt. Medarios,				
Cal.	13.40	.23	.74	62.9
Duke Island	11.49	.06	1.08	67.34
Bee Rocks	8.63	None.	2.68	67.34
Alaska	6.92	Trace.	2.69	73.96

Close inspection of the above tables shows a striking difference between the potassium content of *Macroystis* and *Nereocystis*, quite in favour of the latter. Another point of interest is that the iodine content seems to diminish in Northern waters. American kelp is relatively high in potassium and low in iodine as compared to that near Japan which has a much larger percentage of iodine in its composition. Another point of interest in the tables is the relationship of the iodine to the potassium content. Generally the iodine varies inversely with the potash (K_2O) content. This is not always a definite rule, but applies generally (4). Also the nitrogen content varies inversely as the potash content, both for Northern and Southern groves (4). There is a larger percentage of potassium in Northern kelp.

In addition to the potassium content of the plant sodium also occurs to the extent of one-third of the total weight of potassium. Also there are small quantities of phosphates and sulphates of calcium and magnesium. By charring the organic matter and extracting the soluble salts by lixiviation, the soluble potassium and sodium salts are removed. Further burning of the charcoal gives an ash composed of calcium and magnesium phosphate and carbonate, which varies in amount from 3% to 12% of the total dry weight. It has been found that the stipe carries a much higher proportion of ash than the fronds.

According to Turrentine, there is no direct relationship between the various chemical constituents of kelp, and he especially mentions that there is no difference between the iodine content of Northern and Southern kelp (2). It may also be observed from Tables Nos. 3 and 4 of California Bulletin 248 that *Macroystis* contains by far a larger proportion of iodine than *Nereocystis*, the greater amount of iodine occurring in the leaves and only a small portion in the stems, further that the potassium content in both kinds of kelp occurs to a greater extent in the stems than in the leaves. Professor Burd has also shown that *Nereocystis* in the fresh condition contains 91.58% of moisture while *Macrocystis* contains about 86.41%. It is therefore easy to see that *Macrocystis* contains a greater amount of dry matter per ton than *Nereocystis*. It has also been found that the dry matter content of *Nereocystis* contains a little higher percentage of potash than that of *Macrocystis* and therefore gives a more concentrated char (4). However, by comparing the percentage of potash in each of the plants (4) mentioned above, it is noticed that *Macrocystis* contains a higher percentage of potassium in the fresh state, due to its having a higher percentage of dry matter, even though the dry matter itself is inferior in potash content to that of Nereocystis. Con-

sequently a ton of *Macrocystis* contains a greater total amount of potash in *the green* state, than a ton of *Nereocystis*.

Methods of Harvesting Kelp (2) (7)

The harvesting machine embodies the principles of the ordinary mower, insofar as the actual cutting device is concerned. Instead of the wheel there is a boat or barge, which is fitted on one end with an adjustable cutter bar. This bar really consists of a horizontal knife and two vertical knives so placed and operated as to cut a clean swath, usually to a maximum of twelve feet. Behind the cutter-bar is an endless apron made of chains and hooks and designed to "grab" the cut material and elevate it up to the barge where it falls into the shredders and is chopped up in short lengths. The material is deposited on to a conveyor which loads the scow that usually accompanies the harvester. The harvester is not self-propelled but its machinery is operated by a small gasoline engine. Both barge and harvester are usually tied together and are pushed along by a launch. The position of the harvester in relation to the barge, can of course, be changed so as to make the loading uniform. When the barge is completely loaded the launch makes for the docks where the kelp is quickly unloaded. This system is rather slow and cumbersome and no doubt will be greatly improved in the future as several new designs are now being patented. The cost of harvesting is about $.50 per ton, but can easily be reduced to $.25.

Recovery of Potash and Iodine

All kelps when drying lose a certain amount of their potassium salts by diffusion through the cell walls. This produces a crust of the soluble salts upon the stems and leaves. From Table 6 of California Bulletin No. 248, can be seen the comparative efflorescent effect of *Macroystis* and *Nereocystis*. A greater loss in the latter occurs unless special methods are used for recovery. The leaves or fronds of *Macrocystis* are not subject to this phenomena, but the stems of this kelp, together with the leaves and stems of *Nereocystis* effloresce to the extent of 15%, 24%, and 43% respectively.

It is interesting that this salt is almost free of iodine and contains about 63% of potassium oxide. This would represent a muriate of relatively high purity—around 95%. The fact that only about 50% of the total salts are effloresced makes it necessary to further extract the kelp with water using various methods. Hence it is not necessary to go through a preliminary drying process unless a dry process of charring is to follow. In this case all of the organic matter would be lost. It has been found that the extraction of salts by the wet process (not charring) causes a large amount of colloidal organic matter to separate out in the extract and subsequent drying and evaporation produces salt crystals that are discolored. Hence it has been found necessary to ignite the salt and burn off the organic matter. Recrystallization then gives salt of a fairly high degree of purity.

It has been suggested that kelp be dried and ground and placed upon the market as a low grade potash fertilizer. However, this procedure involves a loss of iodine. The following is a list of possible methods of treatment of kelp for agricultural purposes. The iodine content could be recovered as a by-product and should be considered in reducing the cost of the process.

(a) Partial drying—separation of effloresced salts. Drying and grinding the residuum for use as low grade potash fertilizer.

(b) Extraction of most of the potash and iodine from fresh or dried material by lixiviation; evaporation of solution to dryness and charring, followed by separation of potash and iodine from the char; drying and grinding the residuum and placing it on the market as a humus fertilizer.

(c) Complete charring and lixiviation of the kelp. Only 80% of the iodine content can be saved this way.

(d) Dried and ground kelp as crude source of potash to be applied directly to land. The iodine is lost in this process and transportation difficulties interfere.

Turrentine found that the best method for extraction of potash from kelp was to char the material and activate the char by subjecting it to a special heat treatment. This process seems to allow a more complete extraction of the potassium salts. Other products recovered are bromine, iodine and charcoal. "Activated char" averages 75% of total water soluble constituents, of which 52% is composed of potassium chloride.

Turrentine's method of "counter current lixiviation" seems to be a good one and depends upon the theory of washing precipitates, namely that small amounts of water applied, allowing time for complete drainage each time, will wash the precipitate thoroughly with the least possible amount of water.

A system of tanks constructed of wood (cypress) and having revolving agitators of the spiral paddle type are arranged one above the other so that gravity can be utilized in emptying and refilling. These tanks are 14″x14″x7′ 6″. They are so placed that, although one is directly above the other, their ends coincide with a perpendicular. Hence the sprocketed journals are directly in line and the sprocket chain serves to connect all of the agitators so that power transmitted to one end of the system serves to run all of the agitators. Each tank is high enough above the one next to it to allow for a circular rotary filter to be connected between the two. Connected to each filter is a vacuum line that leads to a main, and at the junction of that line to the main is a hydraulic pump, which is connected to the vacuum line by a valve. The main itself consists of a long pipe of a composition that resists action of salt solutions and is vacuated by a vacuum pump. The whole system is designed with a view to minimum expense and extraordinary simplicity.

Operation of Lixiviator (3)

Eleven hundred pounds per hour of char, containing 52% of potassium chloride, are fed into tank No. 1, which means the one highest up in diagram. The mixers thoroughly stir the mass, and the solution admitted gradually extracts the soluble salts. The mixing goes on for a few minutes and then the valve is opened and the contents of Tank No. 1 are allowed to flow down into the rapidly whirling filter where the liquor is quickly extracted and flows down to the vacuum head where it is pumped to the storage tanks for further purification. The residue is then disengaged from the sides of the filter with steam or compressed air and the contents are transferred to tank No. 2. Here the agitators break up the lumps of char and soon the whole mass is again subjected to the process of extraction and after a few minutes the sludge is drained off and filtered as before; the filtrate is transferred by pump No. 2 to tank No. 1. The char, now in its second stage of lixiviation is transferred to tank No. 3, where it is agitated with *fresh hot water*. After a few minutes the process of filtration is again repeated and the char as it emerges from the filter contains only 1.2% of potassium chloride and 70% water. The filtrate in this case is transferred to tank No. 2 and from there to tank No. 1 where it comes into contact with the more concentrated char and is later filtered off and pumped into the reservoir. The principle of the counter current lixiviator is that the water or solvent is travelling in the opposite direction to the solute, and by this means a maximum concentration of potassium chloride can be obtained with a minimum of water. Also the amount of salt remaining in the char is very small, for in the last extraction pure water only was used.

The solution obtained for storage contains 25% KCl and is produced at the rate of 260 gallons per hour.

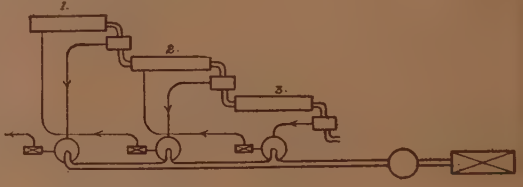

Diagram of Lixiviator.

ANALYSIS OF CHAR GOING THROUGH PROCESS

The original char contains—

Total water soluble solids	75%
Potassium chloride	52%

	Agitators		
	No. 1	No. 2	No. 3
Temp. of sludge	94°C.	66°C.	55°C.
Temp. of soln.	65°C.	56°C.	50°C.
Gravity Be	24	7.5	.5
Percent KCl by Col.	25.8	9.0	1.4
Percent KCl in filter cake	20	2-7.1	1.2
Percent moisture in filter cake	—	—	70

NORMAL CAPACITY AND EXTRACTION EFFICIENCY

Activated char lixiviated per hour	1100 lbs.
Equiv. KCl entering system per hour	572 lbs.
Strong brine produced per hour	260 gals.
Equiv. KCl extracted per hour	560 lbs.
Final filter cake discharged per hour	990 lbs.
Equiv. KCl discharged per hour	12 lbs.
Percent efficiency	97.9%

Cost of Operation

All run by one man and use of hydrometer.

With uniform feed of char the conditions are regulated by the amount of water fed into tank No. 3.

AVERAGE COST PER TON OF LIXIVIATED CHAR.

Labor at $5.50 per day	$1.25
Electric power at $0.25 per KW.hr.	1.62
Steam	.11
Water 628 gals. at .20 per 1000	.128
Miscellaneous supplies	.53
Gross cost per ton	$3.638

Suggestions for Improvement

Because the alkaline solutions have a corrosive action upon steel and cast iron, it is necessary to use some alkali proof metal for all pipes, pumps and valves in the system.

It has also been found that brass and copper set up serious electrolytic action and their use must be avoided.

All vats should be made of pine or cypress and should be rectangular in transverse sections and have a semi-circular bottom to allow more intimate contact of the sludge with the agitators. Vats should also be provided with wooden covers to prevent excessive loss of heat. The agitators should be of the spiral paddle type.

To increase the efficiency of "extraction" it would be necessary to increase either length or number of vats, increase speed of agitators, or increase the speed of the rotary filters, thus reducing the water content of the filter cake in the latter case.

Statistics (6)

Only 17,700 tons of K_2O were produced in the U.S.A. during the period from 1915-20. Of this 10% was obtained from insoluble K_2O deposits, 70% from soluble and 20% from organic material.

Kelp as a Fertilizer

Many years ago the Scotch found an agricultural use for kelp. These people even commercialized the use of kelp by selling, at a special price, the kelp-harvesting privilege of certain lands adjacent to the sea. Later, these practices were begun in New England and in fact all up and down the Eastern coast, extending into Canada. It has been common practice to gather kelp in the fall of the year in the Maritime Provinces much as we would set a special time to cut hay. The material is dragged upon the beach, dried and hauled away to the farms, where it is evenly distributed over the land and plowed under. The species of kelp in the Pacific Ocean is a much larger variety than that found in the Atlantic and contains a much higher percent of potassium chloride. For this reason they have been used much the same way as mentioned above, near San Pedro, where the kelp has been dried and shipped out to the ranches and farms for fertility purposes. In the green state this kelp contains about 2.6% potash and 0.3% nitrogen. These values can be calculated by figuring the water-free composition on a basis of 85% moisture. Such an application of kelp to soil would be of benefit principally to the mineral constituents. The nitrogen applied is almost negligible from a fertility stand point. However, the improved tilth and structure of the soil due to incorporation of organic matter might be of some value in itself.

COMPARISON OF KELP WITH OTHER MANURES(4)

	% Moisture	%N.	%K_2O	%P_2O_5
Green alfalfa	75.3	.72	.45	.15
Cow peas	78.81	.27	.31	.98
Wet kelp	85.00	.30	2.50	.20
Stable manure	73.27	.50	.60	.30

From this table it is easily seen that kelp is comparable with the ordinary green manures and farmyard manure, but due to its bulk, the use is necessarily restricted to the areas close to the source of supply. In the opinion of Turrentine the most useful way to put kelp on the market as a fertilizer, considering the cost of harvesting and concentration, also the by-products and their probable value, is to dry and grind it and supply the demand insofar as it would be economical to do so. The resulting product would be a dark powder weighing about 51 lbs. per cu. ft. and containing about 10% of moisture. It does not readily absorb moisture and become damp, but if it gets wet it forms a sticky gelatinous mass.

Assuming the dry matter to contain 15.8% potash and 1.95% nitrogen, the value of a

ton of ground kelp, considering nitrogen worth $3.30 per unit and potash at $1.00 (a unit representing 1% of a ton or 20 pounds) would be—

15.8% at $1.00	=	$15.80
1.96% at $3.30	=	6.47
Total value per ton	=	$22.27

Naturally kelp on the market in this state would be used in mixing complete manures, as it is distinctly a potash carrier. However, in this respect it would be forced to compete with the German crude magnesium salts, Kainite ($Mg\ SO_4 . KCl . 3H_2O$) also with manure salts which are a mixture of calcium, sodium, potassium and magnesium salts. Pure Kainite has a theoretical content of 18.9% of potash, but it is usually impure and carries about 12.5% potash and sells for about $8.25 per ton. Manure salts are a mixture of crude salts containing from 16—20% of potash. Kainite itself is gradually disappearing from the market as it is being classified as manure salts.

It has been argued by some that the sodium chloride content of kelp detracts from its value as a fertilizer, as the application of sodium to soil causes a deleterious effect by producing alkali. It unites with the sulphate radical to produce white alkali, the carbonate radical to produce a black alkali and the nitrate radical to produce brown alkali. It may be said in defence that the content of NaCl in kelp is not excessive and that it would not be applied in large enough quantities to cause injury; further, that the ordinary manure salts carry metals that are also quite injurious to the soil, though this is not considered by the ordinary purchaser. Again, the large amounts of material in manure salts is inert insofar as plant food is concerned and when used in mixtures of complete fertilizers the resultant product requires a high freight rate on a relatively small amount of material that may be of actual benefit to the plant. On the other hand the organic matter in kelp is light and although its value is small, it really does produce a certain amount of humus and adds organic matter to promote bacteriological activity.

Comparison of Alunite, Kelp, Potassium Sulphate and Potassium Chloride in Fertility Value (5)

A comparison of the manurial value of kelp with that of some other potash carriers may be of interest. Such a comparison was made by Skinner and Jackson (5). Alunite, a potash mineral of the formula

$$K.\ (Al0)_3(SO_4)_2.3H_2O$$

has been extensively used in the investigation because it occurs in quantity and could be fairly cheaply supplied. From this substance is manufactured alum or ordinary $KAl\ (SO_4)_2.12H_2O$ by merely heating and then crystallizing out the pure product. Further heating however, tends to drive off oxides of sulphur, leaving a residue composed chiefly of potassium sulphate and aluminium. It has been suggested that it might be more practical to use the ignited alunite directly as a fertilizer instead of going to the trouble and expense of leaching out the soluble potassium salts.

A comparison of the relative value of kelp and ignited alunite was made in this way. The alunite, carrying 10% K_2O was finely ground. Also the ignited alunite was pulverized and found to contain 14% K_2O. These minerals were applied to the soil in such quantities as to add 25, 50, 100, 200, 500 pounds of potash per acre. Equivalent amounts of potassium chloride and potassium sulphate were used as a check. In conjunction with this, dry powdered kelp containing 19.8% potash, was applied in amounts equivalent to the potash applied above. Thus a comparison between alunite and pure potassium salts as well as kelp was observed.

The method of procedure was merely laboratory pot cultures, which do not give results comparable to field conditions but are suitable for general comparisons. The soil used was a Carrington loam and is known to respond well to potash fertilizers. The soil was mixed, the fertilizer added on Oct. 22nd, and was potted on Oct. 28th. Three pots, each holding about a pound of soil, were used for each treatment and six wheat plants were "set out" in each pot. These plants were allowed to grow until November 29th, when they were cut and weighed in the green condition. The weights are correlated in the following table, the check being taken as 100:

EFFECT OF ALUNITE AND KELP ON GROWTH AS COMPARED WITH POTASSIUM SULPHATE AND POTASSIUM CHLORIDE.

Treatment	Quantity of K_2O added per acre	Green Weight	Relative Growth	
	(Pounds)	(Grams)	(Percent)	
Soil untreated		3.35	110	
	25	3.70	110	
	50	4.00	119	
Soil + raw alunite	100	4.02	120	114
	200	3.77	112	
	500	3.72	111	
	25	4.58	136	
	50	4.77	142	
Soil + ignited alunite ...	100	4.80	14	140
	200	4.80	143	
	500	4.53	135	
	25	3.93	117	
	50	4.67	139	
Soil + kelp	100	4.80	143	131
	200	4.40	131	
	500	4.30	128	
	25	4.27	127	
	50	4.33	129	
Soil + K_2SO_4	100	5.12	152	138
	200	4.52	135	
	500	4.90	146	
	25	4.40	131	
	50	4.33	129	
Soil + KCl	100	4.50	134	131
	200	4.37	130	
	500	4.40	131	

Here it is seen that the best result obtained was that from the use of 100 pounds of *potassium sulphate per acre.* It is not understood just why the potassium sulphate would yield a better crop than potassium chloride, but the results point with favor to the former. Generally speaking the weight of the salt used was equivalent to 100 pounds of potash which seemed to give the optimum results while amounts greater or less tended to reduce the yield.

All the fertilizers gave an increased yield over the check, but it should be noticed that the raw alunite gave the lowest results. The ignited alunite gave the best general results in relative growth while the potassium sulphate came close second. A point of interest is to note that the kelp produced a relative growth, considering all quantities used, equivalent to that of potassium chloride—the potassium in kelp is in the form of potassium chloride. Other experiments were carried out on different types of soils and it was found that the same general conclusions hold good, that the average relative growth for the ignited alunite was greatest in all cases, but that an addition of 100 pounds of potassium sulphate per acre gave the best results in all cases. The soils treated with potassium chloride and kelp are approximately equal in producing power, while those containing the addition of raw ground alunite gave the least returns.

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Control of American Foul Brood.

DAN H. JONES,

Professor of Bacteriology, Ontario Agricultural College, Guelph, Canada

Owing to the recent good work of White and Sturtevant in devising a culture medium (yeast-egg-yolk agar) on which *B. larvae*, the cause of American Foulbrood, will grow, the bacteriological testing of the effectiveness of disinfectants on diseased combs has been made practicable.

In February of this year Mr. Sturtevant, on request, kindly forwarded us his method of preparing this culture medium and immediately a series of experiments was commenced for testing a number of disinfectants on the spores of *B. larvae* as they occur in the larval scales in combs affected with the disease.

For treatment the affected combs were placed on edge, right side up and weighted down in museum specimen glass jars. The solution to be tested was then poured in and the jar shaken so as to agitate the solution, thus facilitating the displacement of air bubbles from the cells.

Streak cultures on yeast-egg-yolk agar slopes were made in each case from the larval scales before the combs were treated, then after they had been immersed for twenty-four hours and again after they had been immersed for forty-eight hours. Combs were allowed to stay immersed in some solutions for six days and one for eighteen days.

1. Spores of *B. larvae* from latval scale; stained carbol fuchsin, x 1000 di. (original).

All cultures were incubated at 37°C. and examined daily thereafter up to fourteen days before a negative result was recorded. In every examination whether there was visible growth on the culture or not, smears were made on microscope slides and stained by Gram's method. Where, in the following report, it is stated that growth of *B. larvae* occurred, it means that there was not only typical visible growth on the culture but that Gram's stained smears made from the culture showed typical *B. larvae* in the vegetative condition.

The following disinfectants were tested: Izal, Chlorazene, Be-Health, Huntzelman's solution and Formalin.

IZAL is a coal tar product said to have a phenol coefficient of 18-20. It is said to kill anthrax spores in four hours and is used in Great Britain to combat various bee diseases as it is non-irritant and the bees do not mind its use about the hives. It is used as a general disinfectant in the strength of 1-300 of water.

The following dilutions of Izal were tested: (a) diluted with water: 1-300, 1-200, 1-100; (b) diluted with denatured alchohol; 1-400, 1-100; (c) 1-50 water+50 denatured alcohol.

Before immersion of the combs the larval scales in open cells were hard and dark brown; after immersion the scales were soft, pulpy and somewhat ropy, and light brown in color thus showing that they had been thoroughly soaked.

Cultures made from open cells after this treatment showed good growth of *B. larvae* in all cases, even after six days' immersion in four cases and eighteen days' immersion in one case.

CONCLUSIONS—Izal is not effective in killing the spores of B. larvae as they occur in larval scales in combs.

CHLORAZENE (Dakin's new antiseptic and surgical disinfectant) said to have a phenol coefficient of 50+.

A one per cent solution was prepared and combs immersed. Streak cultures from scales from open cells were made after twenty-four hours and forty-eight hours immersion.

Result—The scales became soft and pulpy but good growth of *B. larvae* developed in all cultures.

CONCLUSIONS—Chlorazene, one per cent solution in water, is not effective in killing spores of *B. larvae* as they occur in larval scales of affected combs, after forty-eight hours immersion.

BE-HEALTH, said by its manufacturers to be "a special hypochlorite prepared particularly and only for foulbrood of bees."

Foulbrood combs were immersed in this solution, full strength, and cultures made from the larval scales in open cells after twenty-four hours and forty-eight hours immersion.

2. *B. larvae*—smear from culture 6 days old on yeast-egg-yolk agar slope at 37°C. inoculated with larval scale from infected comb after being immersed in "Be-Health", full strength, for 48 hours. Gram's stain: x 1000 di. (original).

Result—Good growth of *B. larvae* developed in all cultures.

CONCLUSIONS—Be-Health is not effective in killing the spores of *B. larvae* as they occur in larval scales of diseased combs after forty-eight hours immersion.

NOTE: The combs were much blanched and the wax denatured, the cell walls being made friable, causing them to crush badly on being handled.

HUNTZELMAN'S SOLUTION — A commercial preparation of formalin and denatured alcohol prepared especially for treating combs affected with American Foulbrood .

Foulbrood combs were immersed in this solution and cultures made from larval scales both from open cells and capped cells after twenty-four hours' and forty-eight hours' immersion.

Result—All cultures made from open cells after twenty-four hours immersion remained sterile thus showing that the spores had been killed. Two cultures out of six made from capped cells after twenty-four hours showed growth of *B. larvae* on four days' incubation.

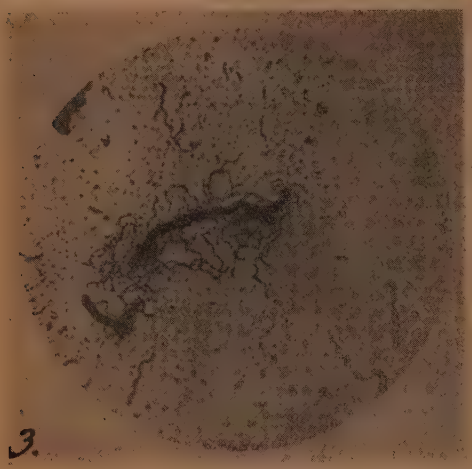
All cultures made from both open and capped cells after forty-eight hours' immersion remained sterile up to fourteen days of incubation at which time it was decided that all spores were killed.

CONCLUSIONS — Huntzelman's Solution is effective in killing the spores of *B. larvae* in twenty-four hours in foulbrood affected combs when it comes in contact with the larval scales as in open cells. In case of capped cells, however, it would appear that forty-eight hours' immersion is essential.

FORMALIN—The sample used was guaranteed to be at least 37 per cent formaldehyde.

This formalin was diluted with water in the following proportions: 50-50; 25-75; 20-80; 15-85.

Foulbrood affected combs were immersed in each of these solutions for twenty-four hours and forty-eight hours, after which periods cultures were made from the scales from open cells and capped cells on yeast-egg-yolk agar slopes.



3. *B. larvae*—Loeffler's flagella stain from culture 5 days old on yeast-egg-yolk agar slope 37°C. x 1000 di. (original).

Result—All cultures made from scales from open cells of combs immersed in any of the dilutions for either twenty-four or forty-eight hours remained sterile. Cultures made from capped cells immersed for twenty-four hours showed growth of *B. larvae* in twenty per cent cases.

All cultures made from capped cells of combs immersed for forty-eight hours remained sterile.

Conclusions—Formalin diluted with water in as high a dilution as 15% formalin to 85 of water is effective in destroying in twenty-four hours the spores of *B. larvae* as they occur in larval scales in open cells.

Although in our experiment a forty-eight hour immersion of the combs in the formalin and water mixtures gave us a hundred per cent sterile results in the cultures made from capped cells we can scarcely expect that such would always be the case as the porosity of the cell caps varies considerably.

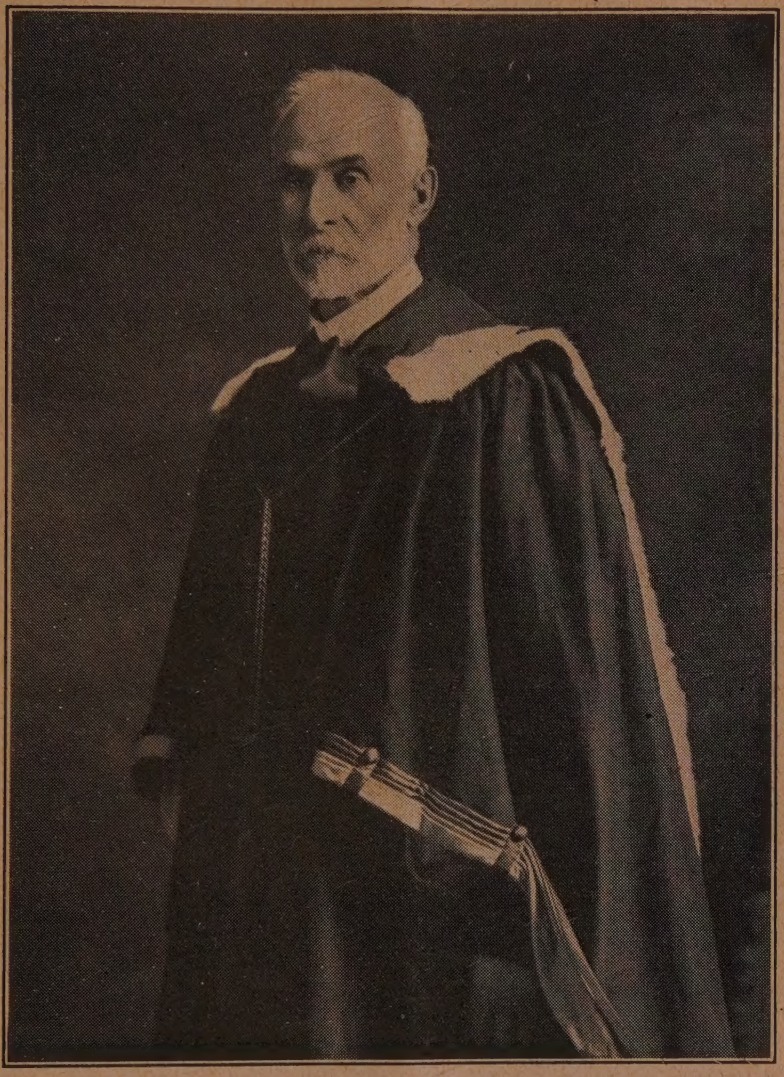
In view of the fact, however, that in our experiments the formalin water mixture gave equally good results in the destruction of *B. larvae* spores as the formalin alcohol mixture known as Huntzelman's Solution we are recommending its use in 20 per cent strength for brood combs and super combs to Professor Millen, Apiculture Department, O.A.C., for experiments on a large scale during the present season.

A detailed account of the laboratory experiments and a full description of the apiary experiments will be published later.

NOTE: Owing to the fact that the odor of formalin remains on the treated combs for a considerable time after treatment, thus rendering the combs objectionable to the bees until the formalin has all passed away, an attempt was made to get rid of the formalin when taking the combs from the solution and it was found that a thorough rinsing of the combs under the water tap for a few minutes removed all odor of the formalin.

Use of Lime or Carbonate of Lime.

Dr. Frank T. Shutt, Dominion Chemist, in discussing the question as to whether lime or carbonate of lime is preferable, says the character of the soil and the desired rapidity of action should be considered. He then proceeds to say that on account of their influence in hastening the decomposition of the humus, quick lime and slacked lime are not so desirable or safe to use on light, sandy and gravelly loams, as are ground limestone and marl. If quick or slaked (hydrated) lime be applied to these soils it should be in small dressings not more than 1,000 pounds per acre) and at long intervals. Carbonate of lime (limestone and marl) is much milder in its action and an excess can do little or no harm. For heavy clays, or soils rich in organic matter, mucks and peaty loams, lime or slaked hydrated) lime is to be preferred and may be applied in fairly large amounts —say 1½ to 3 tons per acre.



M. I.-J.-A. Marsan, premier docteur ès-sciences agricoles de la province de Québec, Lauréat Très Grand Mérite Agricole, professeur émérité d'Agriculture, pionnier du progrès agricole dans la province de Québec.

Monsieur I.-J.-A. Marsan n'est plus. Il s'est éteint, le 25 avril dernier, à l'âge de soixante-dix-neuf ans et sept mois, à l'Assomption, au sein de sa famille patriarcale. Il emporte avec lui un peu des traditions et de l'esprit chevaleresque et désintéressé d'un autre âge.

Monsieur Marsan a été le pionnier du progrès agricole dans la province de Québec. Il n'a toujours vécu que pour les autres. Il autrui, n'oubliant toujours que lui-même, pour servir la cause à laquelle il avait voué sa vie: le développement de l'agriculture.

Monsieur Marsan était né à Saint-Roch de l'Achigan, le 19 juillet, 1844, du mariage d'Isidore Marsan, cultivateur, et de Félonise Poitras. Il fit ses études classiques au Collège de l'Assomption. Il eut pour condisciples plusieurs personnages célèbres qui l'ont devancé dans la tombe, de quelques années: Sir Wilfred Laurier, l'honorable J.-Israel

Admis à l'étude du droit, il entra comme clerc au bureau de feu le juge Loranger, dont il conserva toujours un souvenir ému. Mais sa vocation l'appelait ailleurs qu'au temple de la Chicane. Déjà, on avait fondé l'Ecole d'Agriculture de Ste-Anne de la Pocatière, et, sur les conseils du ministère de l'agriculture du temps, feu l'honorable Louis Archambault, notaire de l'Assomption, le jeune disciple de Thémis entra à Ste-Anne, où il fut, avec feu le sénateur P.-Landry, l'un des pionniers et l'un des plus brillants parmi les élèves de l'institution.

M. Marsan à son retour de l'Ecole d'Agriculture de Ste-Anne, en 1867, fonda celle de l'Assomption dont il fut l'âme dirigeante jusqu'à sa fermeture. En 1903, il commença à donner des cours à l'Ecole d'Agriculture d'Oka. En 1908, lorsque cette dernière, devenue Institut Agricole, fut affiliée à l'Université Laval, M. Marsan en fut nommé le directeur scientifique.

Le 11 mars 1868, il était fait ingénieur agricole par la Chambre d'Agriculture du Bas-Canada et devenait ex-officio membre de cette chambre. Il fut le premier membre du Conseil d'Agriculture de la Province de Québec qui remplaça la Chambre d'Agriculture du Bas-Canada. En 1875, il fut nommé conférencier agricole par l'honorable Louis Beaubien, alors ministre de l'agriculture. Il fut, en 1885, avec feu J.-A. Gigault et William Saunders, l'un des promoteurs des fermes expérimentales. En 1900, il fut désigné comme secrétaire des juges et rapporteur des concours du Mérite Agricole de la province de Québec, position qu'il occupât jusqu'à sa mort. Il était le secrétaire-trésorier de la Société d'Agriculture du comté de l'Assomption depuis 46 ans.

En 1914, l'Université Laval, pour reconnaître ses mérites, le nomma doyen des sciences agricoles et lui décerna le titre de docteur ès-sciences agricoles. En 1921, Sir Charles Fitzpatrick, lieutenant-gouverneur de la province de Québec, lui décerna le diplôme de très Grand Mérite Spécial en reconnaissance des services qu'il avait rendus à l'agriculture.

Plus d'une fois on jeta les yeux sur Monsieur Marsan comme candidat aux honneurs électoraux. A la mort de M.-Charlemagne Laurier, frère de Sir Wilfrid, on fit des instances après de M.-Marsan pour qu'il acceptât, dans l'Assomption, la succession politique du député qui venait de mourir, mais, avec sa modestie habituelle, il refusa toujours ces honneurs.

M. Marsan avait épousé, à l'Assomption, le 11 juillet 1871, Marie-Elmire Ernestine Viger, fille de feu le Docteur Viger.

Les vénérables époux eurent le bonheur de célébrer, en 1921, leur cinquantenaire de mariage. Ils ont eu douze enfants dont huit sont encore vivants: Henri, des Pères blancs d'Afrique, missionnaire, supérieur à Malole, Rhodesie Septentrionale, Ernest, prêtre-vicaire, à St-Henri, Tancrède, de la Maison Gunn Langlois, Hector, voyageur de commerce, Prime J., notaire, Georges de la Société des Artisans Canadiens-Français et Mmes R.-T. Beaudoin, Edgar Fortier.

M. Marsan fut l'un des admirateurs de Monseigneur Labelle, le grand colonisateur. Il ouvrit, l'un des premiers, deux lots à la Minerve dont les ressources étaient alors inconnues.

M. Marsan a été un savant modeste, un citoyen probe et droit, un parfait gentilhomme, patriote ardent, un chrétien modèle.

La presse a été unaime à faire l'éloge du défunt et à exprimer le profond regret que cause sa disparition.

La note suivante, que nous empruntons au "Devoir" résume les appréciations des autres journaux.

"Nous avons le regret d'apprendre la mort d'un homme très modeste, qui a été l'un des pionniers du progrès agricole dans notre province: M. I.-J.-A. Marsan.

"M. Marsan a donné à cette cause sa vie presque entière. Pendant plus de cinquante ans, il s'est occupé de questions agricoles, sans en tirer, on l'imagine bien, un grand bénéfice personnel.

"Les débuts furent parfois décourageants, mais, nous racontait-on, le curé Labelle réconfortait son vieil ami: *Ne vous découragez point si la moisson est lente. Il faudra trois générations pour que germe la semence que vous jetez en terre...* Le courageux pionnier vécut assez longtemps pour voir germer cette moisson. Il eut la joie de constater des progrès considérables et d'y applaudir. La province et l'Université proclamèrent ensemble ses mérites et les services qu'il avait rendus.

"Inclinons-nous pieusement devant la tombe de ce bon et modeste serviteur de la patrie."

Habits Des Paysans.

("Les Paysans" C. Delon)

Croiriez-vous qu'à l'époque d'Henri IV chacun n'était pas libre de s'habiller comme il l'entendait?——Je vous ai décrit l'humble et maigre vêtement du paysan: une tunique écourtée qu'on appelait une jacquette c'est-à-dire le petit habit des JACQUES (paysans); par-dessus le petit manteau à capuchon.....Défense aux vilains de porter des vêtements de couleur autre que le bis ou le brun; défense d'avoir des manteaux longs, qui les eussent pourtant bien abrités, par les temps de pluie ou de neige!.....Défense surtout de porter des chapeaux, si utiles aux champs contre l'ardent soleil d'aout, qui vous brule le front et vous éblouit les yeux.....Et pourquoi cela? C'est que cet humble costume était comme un signe d'infériorité, une livrée du servage. En obligeant le pauvre diable à le porter on lui rappelait son abaissement et sa dépendance. Sa jacquette et son capuchon lui disaient à chaque heure: "Tu n'es qu'un manant. Tu n'es pas de même espèce que les autres." Les nobles y tenaient fort à ces choses extérieures qui marquaient les distances. "Il est bon, disaient-ils, qu'on reconnaisse la bête à son poil." Il ne fallait pas qu'on pût confondre, même de loin, un rustre, un vilain, avec un noble homme ou un bourgeois de la ville. Mais voilà qu'un jour une ordonnance du roi (Henri IV) abolit ce bon vieil usage. Désormais on s'habillera comme on voudra,——ou comme on pourra. Le paysan s'il veut, portera vêtements de couleur, manteau et chapeau à sa fantaisie c'était leur dire: "Vous êtes des hommes comme les autres."

Je dois vous avouer qu'au pays, quand la nouvelle fut connue, les bonnes gens ne comprirent pas tout d'abord et n'y firent guère attention. Ils étaient habitués à leur vieux costume.—"Le roi nous donne permission de porter des chapeaux, disait un des malins du village. C'est bien; or nous donne t-il aussi l'argent pour en acheter?"

Mais les femmes prirent autrement la chose. Et au fond elles eurent raison. Elles trouvèrent avec leur instinct sûr, qu'à prendre un costume d'hommes libres les paysans se sentiraient relevés aux yeux des autres et à leurs propres yeux. "Nous voulons dirent-ellesé que nos hommes soient habillés comme des bourgeois." Elles complotèrent entre elles, prêchèrent leurs maris; bref elles l'emportèrent. En sorte qu'à l'une des grandes fêtes de l'été on vit une douzaine de paysans, les plus aisés du village venir à l'église en vêtement de grosse couleur, bleus ou rouges avec de larges chapeaux. Quelle rumeur sur la place! Tout le monde se met au porte pour les voir passer. On eut dit une mascarade! Et de fait ces bonnes gens devaient avoir drole de mine sous ces habits, auxquels ils n'étaient point habitués. Les uns riaient; les autres regardaient avec envie. Pendant plus d'un mois on ne parla pas d'autre chose. Le seigneur rit beaucoup: c'était dit-on un bon diable et il ne prit pas la chose en mal. Mais la plupart des nobles des environs étaient furieux. Ils prétendaient que tout était perdu, "si l'on se mettait à décrasser les vilains." On dit même que plusieurs gentilshommes maltraitèrent ceux de leurs paysans qui avaient osé profiter des ordres du roi.

Au village comme partout ailleurs, après avoir regardé les choses avec des yeux écarquillés, comme un déguisement de carnaval, on finit par s'y habituer. Peu à peu tout le monde suivit l'exemple. On arrangea des costumes plus ou moins différents suivant les pays, quelquefois différents d'un village à l'autre et selon qu'on le trouva commode. (En d'autres pays, le costume changea très peu). Les paysans portèrent des chapeaux.. ce qui les préserva des coups de soleil. Plus tard en certaines parties de la Normandie et de la Bretagne la mode vint de petits bonnets bleus, en sorte que, si l'on voulait parler des paysans, on disait: "Ce sont les Bonnets Bleus".....Nos braves gens eurent l'esprit de conserver leurs bons gros sabots; et je vois qu'au temps du roi Louis XIV des paysans en révolte sont appelés les Sabotiers.

AVIS

Par un concours de circonstances indépendante de notre volonté, nous n' avons pas encore reçu l'article que devait être publié dans ce numéro de la Revue Agronomique.

Nous serions heureux que chacun nous laisse prévoir le moment où il pourra écrire quelques pages pour la Revue afin que l'espace mis à notre disposition soit bien rempli.

La Rédaction Française.

Concerning the C.S.T.A.

REPORT OF ANNUAL CONVENTION

The July issue will contain a full report of all business transacted at the Annual Convention, resolutions passed, amendments to Constitution and By-laws, reports of standing Committees, Presidential address, report of the General Secretary, etc.

The August issue will publish, either in complete or abstract form, the advanced lectures in Agronomy, Animal Husbandry, Economics and Horticulture.

A new volume (Volume V) will commence with the September issue.

APPLICATIONS FOR MEMBERSHIP

Andrews, H. C. (Manitoba, 1920, B.S.A.) Regina, Sask.

Burke, F. W. L. (Saskatchewan, 1923, B.S.A.) Valparaiso, Sask.

Gilbert, G. (Laval, 1923, B.S.A.) Ste. Anne de la Pocatière, P.Q.

Vanterpool, T. C. (McGill, 1923, B.S.A.) Macdonald College, P.Q.

WHO'S WHO

Copies of the C.S.T.A. Who's Who were mailed on May 1st to all members who had ordered them. Those who have not yet sent their $2.00 for this volume should do so at once. A limited number of copies are still available for members who may not have ordered the book previously.

CONVENTION PROGRAMME

The Programmes for the Fourth Annual Convention were mailed to all members on May 17th. Additional copies can be obtained by writing to the General Secretary. It will facilitate arrangements for accommodation if members will notify Mr. Lionel Stevenson, O.A.C., Guelph of their intention to be at the College during the week of June 9th.

PRIZES OFFERED BY CHILEAN NITRAT COMMITTEE.

Members of the C.S.T.A. who have ha special training or experience in soil fertilit should take advantage of the generous offe which has been made by the Director of th Chilean Nitrate Committee, and announce in the advertising pages of this issue. Brief ly, the Chilean Nitrate Committee offer prizes of $75.00, $50.00 and $25.00 t C.S.T.A. members for the three best essay dealing with the use of Nitrate of Soda a a fertilizer, and offers $10.00 to any essa deemed worthy of publication, but not includ ed among the first three prizes. Member who are interested should write to Mr. B Leslie Emslie, Chilean Nitrate Committee Reford Building, Toronto, Ont.

NOTES

J. B. Harrington (Saskatchewan, '20) has been appointed Assistant Professor of Field Husbandry at the University of Saskatchewan, dating from July 1st, 1924. He has just completed his Ph.D. work at the University of Minnesota.

M. Champlin (South Dakota '09), Senior Professor of Field Husbandry at the University of Saskatchewan, is confined to hospital with appendicitis and will not be able to attend the Convention at Guelph.

E. G. Bayfield (Alberta '23) has been appointed Professor of Field Husbandry at the Agricultural School, Olds, Alberta. He has been taking graduate work at Macdonald College during the past winter.

C. F. Bailey (O.A.C. '09), Superintendent of the Dominion Experimental Farm, Fredericton, will be a New Brunswick delegate, with G. R. Wilson, at the Guelph Convention. His name was omitted from the Convention Programme.

J. A. Clark (O.A.C. '06) Superintendent of the Experimental Farm at Charlottetown, will be the delegate from Prince Edward Island.